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Non-Right-Handedness as a Contributor to Incidents/Accidents Reported Within the Aviation Safety Report System

Ruth E. Propper[1], R. Jordan Hinson[2], and Amelia Kinsella[2]

[1]Psychology Department, Montclair State University, Montclair, NJ, 07043, USA
[2]Fort Hill Group, 470 L'Enfant Plaza Ste 4106, Washington, DC, 20024, USA

ABSTRACT

Individual differences in hand use preference are associated with individual differences in cognition, emotion, and behavior. Additional work suggests that non-right-handers (NRH) are more accident prone generally, more likely to suffer from a physical accident resulting in head or severe injury, are involved in more car accidents, and die earlier than right-handers (RH). It is unclear what causal factors result in these accident-related differences between handedness groups, but likely there is an interplay between both cognition and environment. Additionally, the 'right-hand world hypothesis' suggests that the environment is constructed in a manner that is implicitly biased toward right-handers, resulting in physical constraints on NRH performance. Given these differences between RH and NRH, the current work sought to determine if NRH was associated with incidents in air transportation as reported via the Aviation Safety Reporting System (ASRS), a public database consisting of voluntary safety reports about aviation safety events. Out of 225,897 reports from January 1988 to September 2023, two reports referred to left-handedness as being detrimental to performance as a result of the configuration of the environment. Broadly, results suggest limited impacts of NRH on ASRS reported incidents, though study limitations may result in underestimation of NRH-incident relationships.

Keywords: Handedness, Aviation, Human performance, Laterality, Cognition, Left handed

INTRODUCTION

Individual differences in hand use preference are associated with individual differences in brain organization, cognition, emotion, and behavior. For example, Non-Right-Handers (NRH) relative to Right-Handers (RH) have a larger corpus callosum (Luders et al., 2010), increased interhemispheric interaction (Westerhausen et al., 2004; Cherbuin & Brinkman, 2006), and decreased cerebral lateralization (Prichard, Propper & Christman, 2013; Propper et al., 2010). These between-handedness group differences in hemispheric organization have been suggested to underly the superior episodic memory, superior spatial task performance, increased susceptibility to persuasion (Prichard, Propper & Christman, 2013), increased negative affect (e.g. Propper et al., 2010), and increased incidence of mental disorders (Rodriguez et al., 2010; van der Hoorn et al., 2010) in NRH compared to RH.

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While some traits associated with NRH can be considered positive (such as superior episodic memory and spatial task performance), other associations are more negative. In fact, research suggests that NRH differ from RH in accident-proneness. The NRH are more accident prone generally (Fritsche & Lindell, 2019; Larson et al., 1997; Mandal, Suar & Bhattacharya, 2001; Voyer & Voyer, 2015), more likely to suffer a head injury (Macniven, 1994; Zverev & Adeloye, 2001), more likely to suffer from physical accidents resulting in death or severe injury (Coren, 1993), are involved in more car accidents, and may die earlier, than RH (Coren & Halpern, 1991; Halpern & Coren, 1991). In fact, Coren (1993) reported a 6-fold increase in risk of accident-related death in NRH, compared with RH.

It is unclear what the causal factors might be that result in these accident-related differences between handedness groups, but likely there is an interplay between cortically-mediated cognitive processes and environmental factors. For example, NRH is associated with higher scores on the Cognitive Failures Questionnaire (CFQ; Broadbent et al., 1982) and with increased 'mishaps', including injuries resulting in hospitalizations, number of car accidents, and fall/jump-related injuries (Larson et al., 1997). Although increased cognitive failures, such as decreased vigilance, inattention, and lapses in attention may increase accident likeliness, Larson et al.'s (1997) analyses suggested that the association between NRH, increased accidents, and cognitive errors was mediated by additional factors.

One such mediator may be environmental design. Specifically, Coren (1993) suggested that the environment is constructed in a manner that is implicitly biased toward RH, resulting in physical constraints on NRH performance that can result in injury. Supporting this interpretation, within the transportation sector, a study of Indian railway drivers reported more locomotive accidents in NRH versus RH (Bhushan & Kahn, 2006). Specifically, Bhushan and Kahn found that 89% of NRH reported having had a rail accident, compared with only 16% of RH. It was proposed that locomotive cabin design strongly favored RH, such that various driving configurations might obscure the view for NRH, contributing to the higher frequency of accidents in NRH (Bhushan & Kahn, 2006). Interestingly, in the aviation sector, Gawron and Priest (1996) reported decreased performance in a flying simulator when individuals were forced to use their non-dominant hand, regardless of whether the non-dominant hand was the left or the right. In fact, pilots using their non-dominant hand had decreased performance, reported increased workload, and did not show improvement in non-dominant hand ability following training. These results suggest the possibility of an impact of design features within the Air Traffic Organization (ATO) on performance as a function of handedness, or at the very least, the possibility for handedness to impact performance in the aviation sector generally.

In sum, several lines of research indicate the potential for individual differences in handedness to be associated with incidents within the domain of aviation, with these including cortically-mediated cognitive processing biases as well as environmental design favoring the RH. Thus, the current study examined reports in the voluntary reporting system of the Aviation Safety

Reporting System (ASRS) to determine if NRH is associated with incidents within the National Airspace System (NAS).

METHODOLOGY

The ASRS is a public database consisting of voluntary safety reports and related data for aviation safety events and issues (NASA, 2023). ASRS narratives can be examined for themes related to safety to aid in determining contributing factors to incidents, and for developing mitigations. Additionally, reports can be sorted and selected based on many different domains/features, including based on key words within the narratives themselves. It should be noted that ASRS reports are voluntary, and therefore the caveats associated with voluntarily self-reported data apply here. For example, individuals who feel most strongly about an event might be more or even less likely to allow it to be accessed within the system, resulting in selection bias. Additionally, ASRS does not include reports wherein an actual accident occurred. Instead, issues associated with non-accident situations, such as runway incursions, loss of separation between aircraft, or unexpected situations, as well as other events, are within the database. These incidents, similarly to accidents, represent situations wherein lapses in cognitive processes, along with potential environmental factors, could impact performance.

The online ASRS database (225,897 reports from January 1988 to September 2023) was searched within narratives for the keywords: “Left Hand, Hander, Left Handed, Lefty, Leftie, Southpaw, South Paw, Handedness, or Ambidextrous”. In addition, the above words, in addition to those compound phrases with hyphenation, were also searched within a slightly smaller database that included reports until April, 2023 (e.g. Left-Hand, Left-Handed, South-Paw). This slightly smaller database was used because it leveraged a previously downloaded offline version of the database that enabled hyphenated search terms using Microsoft Excel, a feature unavailable within the online ASRS dataset. It is important to note that the terms ‘Left hand’ and ‘Left-hand’ were also used in the search, but ultimately were rejected as search terms (see below). All reporter roles listed in ASRS were included within the search. Inclusion criteria required the reporter to refer to themselves or to someone else being NRH in some manner.

RESULTS

Left Hand (865 reports) and Left-Hand (214 reports) reports were examined for relevancy by extracting the 20 characters before, and the 70 characters after, the keywords/phrase to determine context without the need to read each entire narrative. Additionally, a randomized reading by two independent judges of more than 100 of these reports was also conducted. Results of these analyses revealed that no reports discussed being NRH. Instead, the reports containing Left Hand or Left-Hand focused on ‘left hand traffic patterns’, other aviation-related circumstances, or the side (e.g. the ‘left hand window’). Ultimately, the search terms Left Hand and Left-Hand did not result in any reports referring to personal handedness of either the reporter or of anyone else. On the other hand, derivatives of these terms (e.g. left handedness, left-handed) were retained for examination.

Of 225,897 total reports, using the other words/phrases listed in Methods, 6 reports were returned as matches. Of these, review by two independent judges revealed that 4 reports did not use the terms as being related to hand use preference. Two reports referred to left-handedness specifically. This is a.00088% incidence of NRH implicated in ASRS reports. In both instances it was daylight, and left-handedness was reported as detrimental to performance as a result of the configuration of the environment.

In Report 1 (November, 2005), a Flight Engineer (FE) was reported to have let aircraft stairs down onto a groundworker, resulting in severe injuries. The FE was unable to see the groundworker due to the configuration of the stairs and his use of his left hand.

> *"...ultimately he (the reporter) believes the cause of the accident was the FE's left handedness. Because of the location of B727-200's aft airstair handle, a R-Handed person can lower the stair and easily look out to the aft of the aircraft as the stair descends. When a person lowers the airstair left handedly, they must face more forward, making it difficult to observe obstacles in the airstair's descent path."*

In Report 2 (July, 2009), an emergency situation resulted in the disengagement of autopilot and the requirement of the pilot to perform multiple actions at once. The pilot reported that the situation was negatively influenced by his own left-handedness and the placement of items in the cockpit.

> *"Autopilot disengaged, HSI distracting and covered with post-it note. Used co-pilots DG and magnetic compass and GPS for heading changes. Hand flying and copying new clearance problematic (being left-handed makes this worse)."*

CONCLUSION

Broadly, results indicate a very limited impact of NRH on ASRS reported incidents. Nonetheless, non-right-handedness, and specifically left-handedness, was associated with exacerbating the impact of a situation. In 2005, field of view was impaired due to left-hand use of equipment, resulting in severe injury to a groundcrew. In 2009, a pilot reported that "being left-handed makes this worse" during an emergency situation. Thus, although rarely reported, environmental factors may negatively impact NRH performance within the NAS, sometimes with severe consequences.

There are limitations to the present research that may result in the underestimation of the impact of NRH within the NAS. First, it is important to note that ASRS is a voluntary, self-reported database, and that therefore it is subject to the biases associated with all such data, for example self-selection. Additionally, individuals may not always be aware of, or report, how their NRH contributed to a given incident, and questions about hand use preference are not included within the ASRS system. Second, accidents are not included within ASRS reports. It is possible that accident-related situations associated with being NRH might occur if the factors involved are more likely to produce severe impacts. Third and relatedly, it is possible that additional search terms may capture more incidents. For example, future research could examine all reports containing the word 'hand', which was not feasible here. Thus, it may be that NRH is more frequently associated with incidents than is reported here.

Additional research could assess handedness directly in individuals involved in incidents, in order to determine the impact of NRH on incident frequency, and to gain additional insight into the relationship between NRH and the environment within the NAS. Such research could potentially offer avenues for mitigating any environmental factors that constrain or reduce the performance of NRH.

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