Ranking of Critical Information for Student Air Traffic Management

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Introduction

- With an increase in automation expected to be part of the NextGen Air Traffic Management (ATM) system, air traffic controllers (ATCos) will need to be taught how to use automation in addition to manual, voice based tools (Paas & Gog, 2009).
- The implementation of a NextGen system allows for a decrease in the interaction between pilots and ATCos, while ensuring efficiency and safety as the traffic density of the airspace is increased (JPDO, 2010).
- In order for the NextGen system to be successful, it is important that tool displays are designed to emphasize the most pertinent information to the pilots and ATCos.
- The present study examined what factors ATCos found most critical when managing air traffic.
  - In the literature, three particular attributes of an aircraft in flight have stood out as most critical to the controller: its altitude, heading (trajectory), and speed (Rantanen & Nuñes, 2005).
- We examined whether ATCos had a preference for manual resolutions.
  - It has been found that ATC situational awareness (SA) of spacing information is maximal when ATCos are given more responsibility in the manual conflict resolution process (Strybel et al., 2013).
- The present study also examined whether individual differences in student proficiency (i.e., ATCo Journeyman status) had an effect on what factors ATCos found most critical. Journeyman status is achieved once an ATCo student has become proficient at four basic skills (altitude, speed, heading and structure) to manage air traffic without a loss of separation by the midterm.

Research Questions

1. What factors did ATCos find most critical when managing air traffic?
2. Does journeyman status in air traffic control have an effect on what factors are found most critical when managing air traffic?
3. Is there a preference among student ATCos when using manual resolutions?

Methods

Participants
- 26 students from 2 different internship sessions were trained to manage air traffic over a 16 week radar simulation internship.

Materials & Apparatus
- Multi Aircraft Control System (MACS) software
- Critical Information Questionnaire consisting of a 10-point Likert Scale rating perceived criticality of different information presented in , with 1 being "not at all relevant" and 10 being "critical".

Design (alpha set to .05)
- Research Question 1: One-way ANOVA
  - DV: Participant rating of importance of information provided by air traffic management tools.
- Research Question 2: One-way ANOVA
 - DV: Participant preference for orientation of manual conflict resolutions (lateral vs. vertical).

Results

1. What factors did ATCos find most critical when managing air traffic?

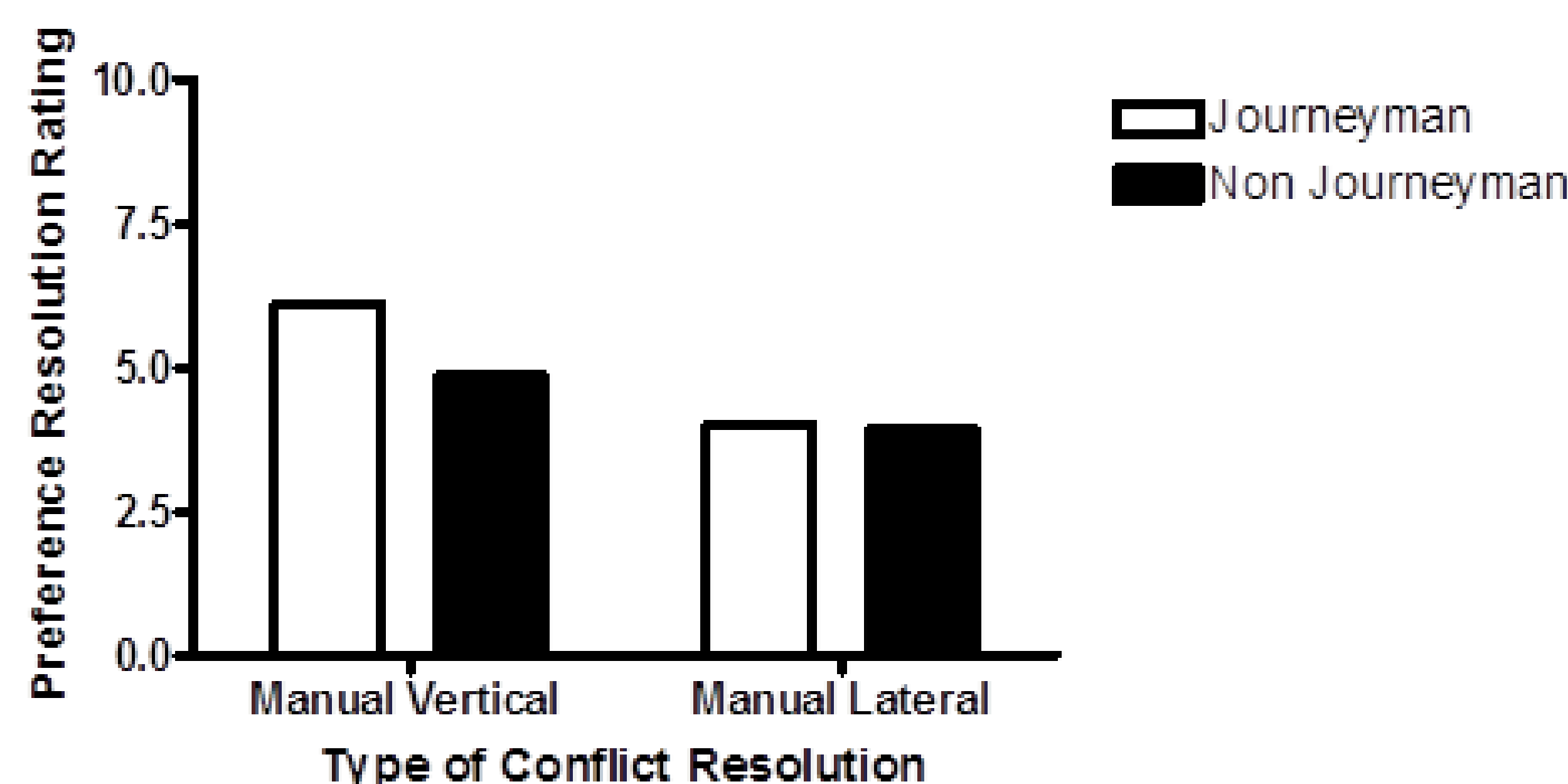| Most Critical Information	Least Critical Information
Overflight AC altitude (M=8.731, SD= 1.433)	Departing AC Speed (M=3.846, SD= 1.89)
Altitude Difference (M= 8.731, SD= 1.779)	Departing AC distance to APALO/PXV (M=3.884, SD= 2.123)
Relative distance between unequipped aircraft (M= 8.308, SD= 1.828)	SDF arriving aircraft speed (M= 4.385, SD= 1.768)

2. Does journeyman status in air traffic control have an effect on what factors are found most critical when managing air traffic?

Journeyman status had an effect on the critical rating of relative distance between arriving aircraft and departing aircraft, $F(1, 24)$= 4.582, p= .043. Non-journeyman (M= 7.000, SD= 1.826) rated this factor as more critical when managing air traffic compared to journeyman (M = 6.631, SD = 2.24).

Relative Distance Between Arriving Aircraft and Departing Aircraft (Critical Information Rating; Journeyman vs. Non Journeyman)
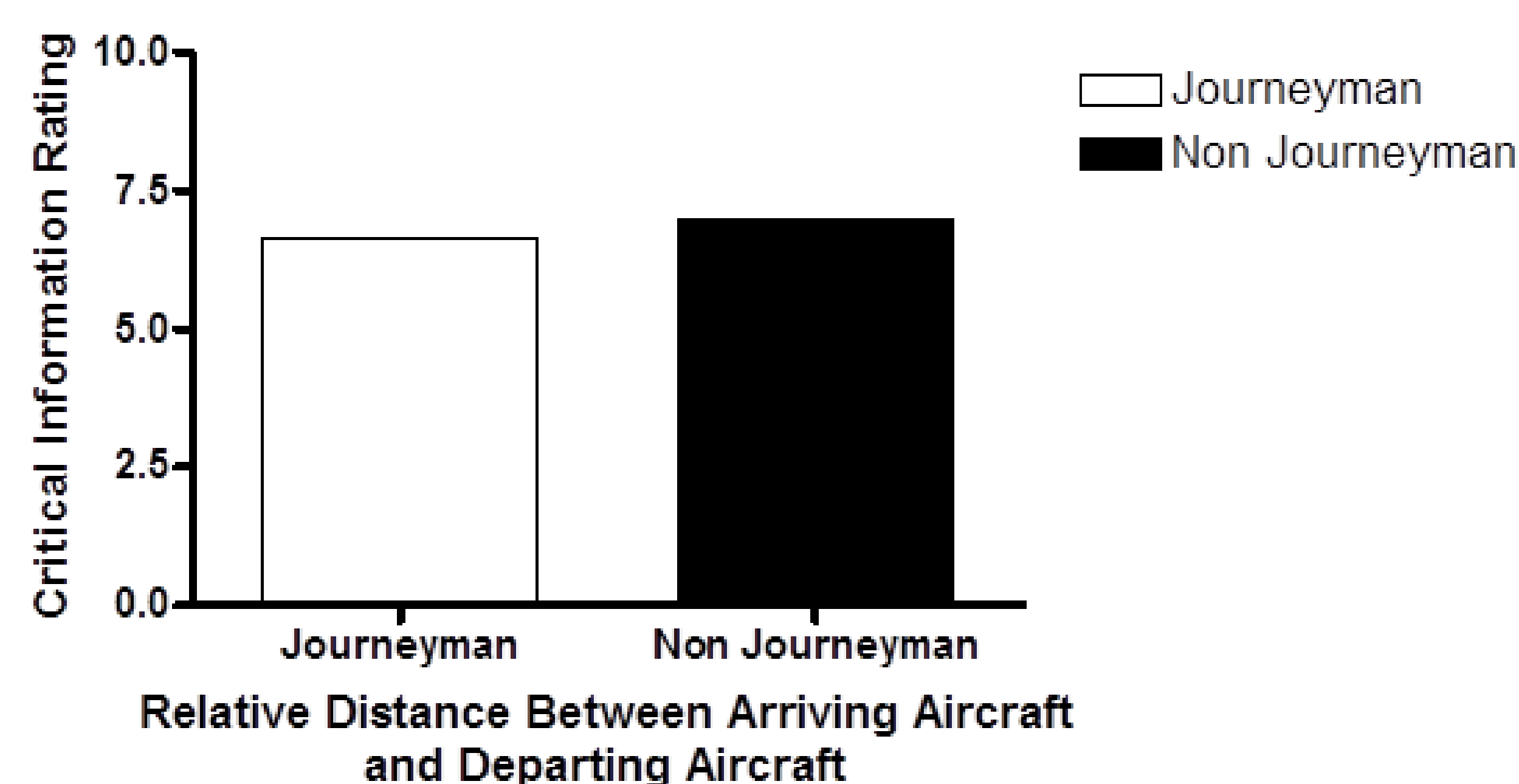
3. Is there a preference among ATCos when solving manual conflict resolutions?

It was found that student ATCos with Journeyman status (M= 6.105, SD= 1.242) preferred resolving vertical conflicts more so than their Non-Journeyman status peers (M= 4.857, SD= 1.464), $F(1, 24)$= 4.704, p= .040.

Type of Conflict Resolution (Preference Resolution Rating; Manual Vertical, Manual Lateral; Journeyman vs. Non Journeyman)

Discussion

Implications/Future Directions

- Since altitude was found to be one of the most critical pieces of information for all ATCos, NextGen systems should move towards making altitude the most, if not more, salient of components of its display. Furthermore, since our results suggested a difference between experience levels in ATCos with respect to other critical information ratings and manual conflict resolutions, we may be able to tailor training/tools for differing levels of experience.
- Though we found that ATCos find little importance in information concerning arriving and departing aircraft, it may be beneficial to examine the possible effects on ATCo performance and SA when said information is made less salient.
- If separation information of arriving & departing aircraft is too intrusive/currently takes up too much space, we can examine whether manipulating the size of its representation on current tool displays has any effect on ATCo performance.

Limitations

- The sample size of the study was not large enough (n=26) and may have resulted in Type 1 error.
- It may benefit us to be able to examine the preferences of licensed ATCos concerning critical information presentation.

References

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