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Changing Perspectives  
on Aviation English  
Training

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# *Aviation English for the Next Generation*

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## **Abstract**

The aviation industry is forecast to grow at a stratospheric rate in the next 20 years. This growth results in an increasing number of students entering flight and Air Traffic Control (ATC) training. Flight and ATC training is often conducted in the medium of English and yet the vast majority of entrants do not have English as a first language. The International Civil Aviation Organisation (ICAO) Language Proficiency Requirements (LPRs) have become an established standard for language proficiency in the aviation industry. This paper begins by arguing that the ICAO LPRs are not a suitable target for entrants to flight and ATC training due to the fact that students neither have a need for the target language addressed by the ICAO LPRs nor possess the background knowledge of aviation required to engage in the professional language use addressed by the ICAO LPRs. The paper then turns to a broad analysis of the language needs of entrants to aviation training and suggests that language training and assessment for student pilots and ATC officers shares much in common with English for Academic Purposes. Finally, the paper presents research into flight and ATC instructors' perceptions of the needs of their students, the results of which suggest that B2 on the Common European Framework of Reference is a suitable entry level for English-medium aviation training.

## **Introduction**

To meet the increasing demand for global air travel, the civil aviation industry is set to grow at a stratospheric rate over the next 20 years. With this growth comes a requirement for a huge number of new personnel to fly an expanding global aircraft fleet and to control a rapidly increasing volume of air traffic. In 2010, the International Civil Aviation Organisation (ICAO) predicted that the world's population of pilots and Air Traffic Control Officers (ATCOs) would more than double by 2030 (ICAO, 2010a). In 2013, Boeing forecasted a requirement for 498,000 new commercial airline pilots by 2032 (Boeing, 2013). In 2015, Airbus predicted that air traffic will double by 2030 with 32,600 new airliners entering service, the majority of which will be delivered in the Asia Pacific region (Airbus, 2015). An increasing number of experienced pilots and ATCOs approaching retirement age further compounds the challenge of personnel shortage. Some have also suggested that the personnel shortage is a threat to aviation safety (IATA, 2015). Indeed, the problem has become so acute in recent years that there has been a major industry-wide drive to attract young people to a career in

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aviation and to identify and address barriers to entry<sup>6</sup>. According to current predictions, many thousands of young people will need to be trained in order to meet the strong demand for personnel in the years to come.

English has long been the lingua franca in civil aviation, and the vast majority of today's licensed pilots and ATCOs do not have English as a first language. With the predictions for growth in the industry, it is clear to see that the proportion of the world's future pilots and ATCOs who do not have English as a first language will grow. This is particularly true when considering that the strongest demand for personnel is in regions of the world where English is not a first language, for example in Asia and the Middle East.

Today, much of the world's ab-initio flight and air traffic control training capacity is in the English speaking world, in countries such as the USA, Canada, South Africa, Australia and the UK. Aviation Training Organisations (ATOs) in such countries are experiencing a high demand from international students enrolling on flight and ATCO training courses. Furthermore, of the aviation training which is conducted in the non-English speaking world, much is conducted in the medium of English. It is becoming increasingly common to find ATOs in France, Georgia, Germany, Hungary, India, Norway, Oman, Russia, Sweden, Taiwan, Thailand and Turkey providing some, if not all, of their ab-initio training programmes in English. Not only is English the lingua franca of flight operations, but it is fast becoming the lingua franca of ab-initio aviation training.

To continue to grow and to do so safely, the aviation industry needs to attract young people and to train them from zero knowledge and experience to the cockpit of a jet airliner or the ATC position as quickly and as efficiently as possible. In service of the industry, of ATOs, of flight and ATC instructors and of the students and their sponsors, English language practitioners play an increasingly important role in helping the industry meet the requirement for new personnel.

## **1. The ICAO Language Proficiency Requirements**

In 2003, ICAO introduced a standard for English language proficiency in a laudable effort to improve aviation safety worldwide. Under the Language Proficiency Requirements (LPRs), all pilots operating on international flights and all ATCOs controlling international air traffic must demonstrate a minimum level of English language proficiency defined by ICAO as Operational Level 4. In the years since the introduction of the LPRs, an enormous amount of language education and assessment activity has taken place. National Aviation Authorities have incorporated the LPRs into their regulatory frameworks, course designers and materials writers have developed language learning content to help pilots and ATCOs reach, maintain and

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<sup>6</sup> For example, ICAO's Next Generation of Aviation Professionals (NGAP) initiatives were launched to ensure that enough qualified and competent aviation professionals are available to operate, manage and maintain the future international air transport system. The IATA Training and Qualification Initiative (ITQI) was created to develop existing and future generations of aviation professionals to meet the demands of an evolving industry.

improve upon ICAO level 4. Language testers have sought to develop instruments to measure the language proficiency of operations personnel and researchers in applied linguistics, language teaching and testing, and organisations advocating aviation safety have continued to explore language proficiency in the context of the LPRs and to promote standards for aviation language training, assessment and use. Though there is much yet to be done, the LPRs have had an important impact and have quickly become the established standard for English language proficiency across the aviation industry. It is not surprising that today it is quite common in many parts of the world to find ICAO level 4 as an entry requirement to ab-initio aviation training. Indeed, it has been argued that ‘It is beneficial for airlines and their flight training providers to ensure that a standard protocol is in place for their flight students to receive valid and reliable language assessments in accordance with these new ICAO language proficiency requirements prior to commencing flight training’ (Albritton, 2007:20). Considering the responsibility that aviation English practitioners carry in equipping students with the language they need for successful aviation training, we might reflect on the suitability of the LPRs in general, and ICAO level 4 in particular, as a target for entry to aviation training programmes. To do so, we will look at the purpose of the LPRs and the language use that they are designed to address against the backdrop of initial aviation training.

### **1.1. Language for professionals**

The ICAO LPRs were developed in response to a series of fatal aircraft accidents in which insufficient English language proficiency was found to be a contributory factor leading to the accident. In Document 9835 *Manual on the Implementation of the Language Proficiency Requirements*, ICAO states that:

The sole object of ICAO language proficiency requirements is aeronautical radiotelephony communications, a specialized subcategory of aviation language corresponding to a limited portion of the language uses of only two aviation professions — ATCOs and flight crews. It includes ICAO standardized phraseology and the use of plain language (ICAO, 2010b, section 3.2.7)

During routine, predictable flight operations, pilots and ATCOs adhere to standardized phraseology which ICAO defines as ‘the formulaic code made up of specific words that in the context of aviation operations have a precise and singular operational significance’ (ICAO 2010b, Section 6.2.8.4). As routine aircraft movements occur according to a set of strictly defined procedures, standard phraseology covers routine pilot-ATC communications and is designed to be readily understood by both parties in order to make standard communications both safe and efficient. However, as Davies notes, where language ‘is formulaic (for example, the English of air traffic control), it must depend on a broader proficiency in order to deal with emergencies which no ritualised code can encompass’ (Davies, 2001: 138). In aviation, when something unusual happens and operations depart from the routine, phraseologies alone may not always be sufficient to cover the communicative needs. In non-routine and emergency situations, pilots and ATCOs may need to use ‘plain

language' which ICAO defines as 'the spontaneous, creative and non-coded use of a given natural language' (ICAO, 2010b, Section 6.2.8.4). ICAO states:

Standardized phraseology should therefore provide the tools for communication in most of the situations encountered in the daily practice of ATC and flight. However, sometimes the unexpected happens. For example an inexperienced pilot gets lost, a technical problem develops on the aircraft, a passenger falls sick, someone provokes a bomb alert, ATC equipment fails or the truly unexpected arises. In these cases, where phraseology provides no ready-made form for communication, pilots and ATCOs must resort to plain language. (ICAO, 2010b, section 3.3.13)

The effective transition between standard phraseology and plain language is referred to by ICAO as 'code-switching'(ICAO, 2010b, section 3.3.21) and is a critical component of the ICAO LPRs.

The LPRs strengthened provisions for language proficiency in the Standards and Recommended Practices (SARPs) of the Annexes 1, 6, 10 and 11 to the Chicago Convention on Civil Aviation, Annex 1 of which stipulates the ability to speak and understand the language used for radiotelephony communications as a prerequisite for personnel licensing. In practical terms, this means that existing pilot and ATC licence holders have to not only adhere to standardised phraseology, but they also need to regularly demonstrate proficiency in plain language in order to retain their licences. In addition, those concluding flight or air traffic control training and applying for an initial pilot or ATC licence have to demonstrate proficiency in plain language at the point of licence issue. As ICAO states, 'If the aeronautical community is considered as one to which an applicant gains admission through the demonstration of any number of competencies determined to be important to the community, then language proficiency is simply another competency' (ICAO, 2010b, section 4.5.4).

Of those intended to be addressed by the ICAO LPRS, some may be private pilot licence holders who fly for recreational purposes and some may be students who are completing their training and about to embark on a career as a professional pilot or ATCO. However, at any given time, the vast majority are experienced professionals who already earn a living from flying aircraft or controlling air traffic. Regardless of professional activity and type of licence held, a characteristic that all licence holders share in common, is, one on hand, that they have received formal training in standard phraseology and use of the radiotelephone and, on the other, a knowledge of radiotelephony communications and the operational procedures they represent. This knowledge is borne out of flying and ATC experience during which pilots and ATCOs routinely use the radiotelephone as members of the international aeronautical community. The fact that entrants to aviation training have yet to receive training in radiotelephony communications, do not have knowledge of or experience with aviation operations nor belong to the professional community raises serious questions as to the suitability of the ICAO LPRs as a target for entry into initial aviation training. To take this further, let's look at the ICAO rating scale at level 4 in more detail.

## 1.2. The ICAO Rating Scale

In order to ‘ensure, as far as possible, that all speakers have sufficient language proficiency to handle non-routine situations’ (ICAO, 2010b, section 4.2.2), ICAO developed an analytical rating scale and a set of holistic descriptors to make explicit the level of language proficiency required by pilots and ATCOs. The Rating Scale addresses speaking and listening skills described across six criteria (Pronunciation, Structure, Vocabulary, Fluency, Comprehension and Interactions) and six language levels where a minimum of level 4 in each of the six criteria is required for personnel licensing. A brief analysis of five of the six descriptors of the rating scale for level 4 (table 1) reveals how the rating scale was designed to capture the requirement for pilots and air traffic ATCOs to handle non-routine communications.

The *Structure* and *Vocabulary* descriptors refer to ‘unusual or unexpected circumstances’ while *Comprehension* and *Interactions* descriptors refer to an ‘unexpected turns of events’. In the context of radiotelephony communications, these descriptors can be interpreted as situations which deviate from planned, routine and predictable aircraft operations. The situations may not have an immediate impact on the safety of the flight, for example, an ATCO advising a pilot that a taxiway is closed due to an aircraft with mechanical failure. On the other hand, the situation may be more urgent, for example, a flight crew experiencing problems with aircraft flight systems whilst in-flight. In all cases, regardless of urgency, the situations are not predictable and are likely to trigger the use of plain language where phraseologies do not suffice. As both pilots and ATCOs are conditioned by what they expect to hear<sup>7</sup>, plain language communications in non-routine situations often contain an element of surprise. As Mell notes, ‘the first obvious quality of emergency calls by pilots via radiotelephony is that they come to the ATCO - literally and metaphorically - "out of the blue"' (Mell, ND). Such messages may give rise to the ‘linguistic complications’ included in the descriptor for *Comprehension* as both parties involved in communication work towards mutual understanding of a situation which is out of the ordinary and which requires more complex language use. To cater for the management of this switch from standard phraseology to plain language, the *Fluency* descriptor refers to the ‘transition from rehearsed or formulaic speech to spontaneous interaction<sup>8</sup>’. Finally, though not linked necessarily to radiotelephony communications *per se*, both the *Vocabulary* and *Comprehension* descriptors refer to a test taker’s ability to talk about and understand ‘work-related topics’ which can be interpreted as any topic connected to the professional lives and activities of pilots and ATCOs, including communications on the radiotelephone.

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<sup>7</sup> A phenomenon known as ‘expectancy’. See Orlady / Orlady (1999).

<sup>8</sup> ICAO defines ‘formulaic speech’ as a ‘restricted or coded use of language comprising fixed standard phrases or lexical and syntactical routines, developed either by consensus for highly repetitive communications (e.g. everyday exchanges of greetings) or formally prescribed for special or professional purposes’ and gives ICAO standardized phraseology as an example of the latter (ICAO, 2010:ix).

Structure	Vocabulary	Fluency	Comprehension	Interactions
Basic grammatical structures and sentence patterns are used creatively and are usually well controlled. Errors may occur, particularly in <b>unusual or unexpected circumstances</b> , but rarely interfere with meaning.	Vocabulary range and accuracy are usually sufficient to communicate effectively on common, concrete, and <b>work related topics</b> . Can often paraphrase successfully when lacking vocabulary in <b>unusual or unexpected circumstances</b> .	Produces stretches of language at an appropriate tempo. There may be occasional loss of fluency on <b>transition from rehearsed or formulaic speech to spontaneous interaction</b> , but this does not prevent effective communication. Can make limited use of discourse markers or connectors. Fillers are not distracting.	Comprehension is mostly accurate on common, concrete, and <b>work related topics</b> when the accent or variety used is sufficiently intelligible for an international community of users. When the speaker is confronted with a <b>linguistic or situational complication or an unexpected turn of events</b> , comprehension may be slower or require clarification strategies.	Responses are usually immediate, appropriate, and informative. Initiates and maintains exchanges even when dealing with an <b>unexpected turn of events</b> . Deals adequately with apparent misunderstandings by checking, confirming, or clarifying.

*Table 1. Selected descriptors from the ICAO Rating Scale at level 4 [author's emphasis]*

Today, it is widely accepted that specific-purpose language tests are designed to engage subject-matter knowledge alongside language knowledge as a test taker interacts with test tasks. As Douglas notes, ‘the [LSP] construct contains, by definition, subject-matter knowledge’ (Douglas, 2000:39). ICAO states that ‘Because of the high stakes involved, pilots and air traffic ATCOs deserve to be tested in a context similar to that in which they work. Test content should, therefore, be relevant to their work roles’ (ICAO, 2010b, Section 6.2.8.3). Furthermore, ICAO developed the rating scale to explicitly address the construct of radiotelephony communications:

The ICAO Rating Scale has a distinct aeronautical radiotelephony focus; it addresses the use of language in a work-related aviation context, voice-only communications, using strategic competences for safe communications in case of complications or unexpected turn of events (ICAO, 2010b, section 4.5.5)

Performing at ICAO level 4 in a test designed to measure language proficiency in this context requires the test-taker to have knowledge of and experience with using standard phraseology and the full range of operational procedures that phraseology represents. It also demands that the test taker knows what constitutes a non-routine situation in aviation operations, and has the strategic competence to code-switch between standard phraseology and plain language in such a situation. If we are to

‘make generalisations about the [test takers’] ability to use language in future real-life situations’ (ICAO, 2010b, Section 6.2.8.3), is entirely appropriate, desirable, even, that tests designed for this specific purpose tap into such field-specific subject-matter knowledge given that the stated audience - licensed pilots and ATCOs - are experts in their field.

Subject-matter knowledge is inseparable from language use, even more so in language for specific purposes. Therefore, we cannot expect entrants to aviation training to be able to speak ‘ICAO aviation English’ knowing that they do not have the associated subject-matter knowledge. Therefore, using tests designed to meet the ICAO LPRs for entrants to aviation training is highly problematic due to ‘the lack of knowledge: a specific test might well assume or presuppose subject knowledge that the testees do not have’ (Alderson, 1981: 127) and would constitute test misuse. In a well-constructed, field-specific test of radiotelephony communications, a test-takers’ known lack of knowledge would impede performance which would not only be unfair to the test-taker but it would also lead to inevitable problems in the validity of inferences made on the basis of test scores. As I have argued elsewhere, ‘performance in a test of LSP for pilots is thoroughly dependent on subject-matter knowledge. To turn the question on its head, if a test-taker did not possess any such knowledge, they would be as unable to perform in such test tasks as they would be unable to fly an aircraft’ (Emery, 2014:208). This is almost certainly the case with entrants to aviation training. Following the same logic, we might suggest that if entrants to aviation training with no subject-matter knowledge *are* able to perform at ICAO level 4 or above in tests purporting to measure language proficiency for the ICAO LPRs, the tests themselves are fundamentally flawed in that their tasks do not adequately trigger ‘an interaction between the test taker’s language ability and specific purpose content knowledge, on one hand, and test tasks, on the other’. (Douglas, 2000:40). That there are tests in use around the world that claim to produce valid measures of language proficiency for both licensed professionals and entrants to aviation training may go some way towards explaining why Alderson concluded that “we can have little confidence in the meaningfulness, reliability, and validity of several of the aviation language tests currently available for licensure” (Alderson, 2011: 1).

### **1.3. Training for the ICAO LPRs**

The purpose of English for Specific Purpose (ESP) is ‘to enable learners to function adequately in a target situation, that is, the situation in which the learners will use the language they are learning’ (Hutchinson / Waters, 1989:12). Chapple & Curtis identify the core characteristics of ESP courses as, amongst other things, being customized to meet foreign language learners’ specific needs and being closely related to professional knowledge (Chapple & Curtis, 2000). Given the highly-specialised nature of language in the context of the ICAO LPRs, the focus for ESP syllabus designers and materials writers has naturally been helping licensed pilots and ATCOs develop the plain language proficiency required to communicate effectively in the context of radiotelephony communications. Indeed, in *Circular 323 Guidelines for Aviation English Training Programmes*, ICAO gives the following guidance:



By incorporating the topics, operational situations and communicative functions which make up the substance of pilot-ATCO radiotelephony communications into their courseware, training providers are preparing their students most effectively for using English in their real-life working environment (ICAO, 2009, section 1.3.6).

We can see this translated in the introductions of three well known ESP coursebooks written to address the ICAO language proficiency requirements:

This course does not aim to teach the phraseology that aviation professionals need but it is included to provide a context for the plain English needed for communication between pilots and air traffic controllers (Emery and Roberts, 2008).

English for aviation has been developed specifically for people who ... need to comply with the ICAO LPRs ... It supports standard phraseology and builds upon it to help improve plain English in the skill areas specified by ICAO (Ellis and Gerighty, 2008:4).

ICAO standard phraseology is the cornerstone of radiotelephony. Standard phraseology, then, is widely used in Flightpath for reasons of contextual authenticity and to allow students to practise the transition between phraseology and plain language (Shawcross, 2001:3).

While such courses contain material that those seeking to become pilots or ATCOs may find interesting and motivating, the stated objectives of such courses presupposes that learners both possess the subject-matter knowledge and professional experience necessary to engage meaningfully with the content and have a need to acquire the target language. ICAO acknowledges that such ESP material is problematic for students of aviation training due to a lack of subject-matter knowledge: ‘In the case of ab-initio students, there will be a great deal of technical or operational subject-matter that cannot be taken for granted (ICAO, 2009, section 1.3.3). More importantly, such courses are not designed with students entering professional aviation training in mind. Given that ‘The ICAO Rating Scale addresses only spoken language (speaking and listening); it does not address reading and writing skills’ (ICAO, 2010b, section 4.5.5), courses that are oriented towards ICAO level 4 and above will fail to address the language skills that students require to function effectively at the aviation training academy, and fail to account for learner language proficiency, learning preferences and styles and the needs, expectations and desires of the academy, its instructors and students. In so many ways, the language proficiency requirements of entrants to English medium aviation training are very different from those of licensed pilots and ATCOs. Thus, if we are to successfully prepare students for English medium aviation training, aviation English practitioners must move away from the ICAO LPRs and go back to the drawing board.

## **2. English for academic purposes**

Entrants to aviation training need language to learn, and as Hyland notes, ‘Teaching those who are using English for their studies differs from teaching those who are

learning English for other purposes' (2006:4). It would seem logical, then, that attempts to address the requirements of students will draw on the principles of English for Academic Purposes (EAP), a branch of English for Specific Purposes (ESP) defined as 'the teaching of English with the specific aim of helping learners to study' (Flowerdew / Peacock, 2001:1). EAP has witnessed unprecedented growth in more recent decades alongside the rapid increase in the numbers of international students attending English-medium further and higher level education. Obviously, flight and ATC training, as vocational training, is very different to under- and post-graduate academic study. Students of aviation training do not conduct library research, write essays, give presentations and so on. At the same time, given EAP's focus on the language proficiency that students need in order to learn, EAP is particularly relevant in a consideration of English language teaching and assessment for student pilots and ATCOs.

Ryland (2006, p1) suggests that:

Any EAP course starts with the question: 'Why are these students learning English?' It is a question which helps focus the course and make it relevant for learners by taking the world outside the language classroom into account. It means going beyond grammar and vocabulary to prepare students for their future academic experiences while, at the same time, recognizing the importance of affective, personal and social expectations of learning. (Ryland, 2006:73)

We know that students of aviation training are learning English so they can learn, in the medium of English, to be professional pilots and ATCOs. Our next questions relate to needs analysis which is seen as the 'cornerstone' of EAP since it helps determine 'the *what* and the *how* of a course' (Dudley-Evans / St John, 1998:121). Jordan proposes that needs analysis should be the "starting point for devising syllabuses courses, materials and the kind of teaching and learning that takes place (1997:22) Today there is much literature on the subject of EAP needs analysis (see Basturkmen 2010; Benesch, 1997; Brindley 1989; Dudley-Evans and St John 1998; Hamp-Lyons 2001; Hutchinson and Waters 1987; Hyland 2006; Jordan 1997; Long 2005; Richterich 1980; Robinson 1991; West 1994). For the purposes of this paper, let's begin by analysing, in broad terms, the *present situation* and *target situation* of the learners (Dudley-Evans / St John, 1998) by asking the following questions: Who are the learners? What tasks do the students need to do in English during their training? What level of language proficiency do students need to do these tasks successfully?

## **2.1. Student pilots and ATCOs**

As Hyland notes, 'Student populations have become increasingly diverse, particularly in terms of their ethnic and linguistic backgrounds and educational experiences, and this presents significant challenges' (Hyland, 2006, p2) While recognising this diversity, we can identify some of the common and broad characteristics that students of aviation share as follows: Student pilots and ATCOs tend to be young – typically between the ages of 18 and 25 - predominantly male and generally highly motivated by the potential of an exciting career in a dynamic, technologically advanced, well-

respected and relatively well-paid industry. By and large, they are intelligent and are generally well educated, particularly in science, technology, engineering and mathematics (STEM) subjects. For the vast majority that do not have English as a first language, student English language proficiency is varied, from beginner to advanced levels, depending, naturally, on the level and quality of English language instruction they have received and their level of exposure to English. Some are aviation enthusiasts and may have read extensively about aviation, played flight or air traffic control simulators for fun or may have completed some formal aviation training. Some may even have under- and post-graduate education in STEM or aviation-related subjects. However, like many students, the majority of students of aviation begin their training with little knowledge of the domain, if any.

## **2.2. Admissions**

The route to entry into training varies considerably from country to country, as does the depth, nature and importance assigned to the selection and admissions process. In flight training, students may enrol under self-sponsorship where the student bears the financial cost of training independently, either for a complete training programme (integrated training) or a training programme delivered in stages (modular training). Others may be sponsored directly by an airline and/or a government organisation, or training may be conducted under a model whereby successful completion of training leads to a guaranteed job within a particular airline. Here, the admission process tends to be more rigorous. Likewise, air traffic control training programmes are typically sponsored by national Air Navigation Service Providers, entry into which is usually determined by successful performance in initial assessment. Depending on the nature and depth of student assessment, students may also display a high level of cognitive skills and personality traits such as numerical reasoning, hand-eye coordination, leadership, assertiveness, and well-developed interaction and communication skills. The nature, depth, scope and importance assigned to English language assessment varies considerably, from informal impressionistic judgements about language proficiency made in a telephone interview through to the use of specific purpose, professionally produced tests of listening, reading and speaking in the context of initial aviation training.

## **2.3. Aviation training**

As one would expect, courses for pilots and ATCOs vary. Flight and ATC training programmes vary considerably within themselves too, depending on the nature of the training programme and the type of licence the student is working towards. That said, ab-initio training for pilots and ATCOs shares much in common in terms of the environment in which training takes place, the subject-matter that students encounter, the language that is used and the skills that students need to cope with training.

In many contexts, ab-initio training requires that students attend an aviation academy or training centre. Often, residential accommodation is provided for those students who do not live locally. For international students, this requires overseas

travel and an extended period of time away from home during which they will have to adapt to life in a new language and culture. If the language of the training environment is English, then getting to grips with day-to-day life in a new environment and culture is often the first language challenge that non-English speaking students face. Where can you buy a sandwich? Where is classroom 3a? What time do classes finish? Who do I talk to if I have a problem? Getting off to a successful start in training involves speaking to and understanding training centre administrative and support staff as well as other students.

In terms of the formal training programme, and again, depending on the nature of the programme itself, the first weeks of pilot and ATC training is often spent entirely in the classroom undergoing theoretical training and preparing for civil aviation authority written examinations. This theoretical training, known as ‘ground school’ for pilots and ‘basic training’ for ATCOs, shares much in common in terms of subject matter. Both pilot and ATC training syllabi cover a wide range of subjects such as principles of flight, general and radio navigation, aircraft performance, air law, meteorology and human factors. As one well-known independent provider of ATC training states, ‘A number of the course’s theoretical components are similar to the requirements for pilot training because of the close inter relationship within the aviation environment.’ (Entry Point North, 2015).

Theoretical training follows a programme of subject-specific classroom lectures which may be delivered by native and non-native speaking flight and ATC instructors. Classroom lectures typically involve the instructor talking to the students about the key aspects of the subject-matter with supporting visual aids such as slides, PowerPoint presentations and video. Key aspects of the subject-matter are often identified according to their importance in the Civil Aviation Authority (CAA) written examinations which students sit at the end of theoretical training. The students often have the relevant pages of the subject-specific textbook open and on the desk in front of them to which the instructor may refer, particularly to identify the salient points of the lecture. The instructor may also distribute handouts to the students.

The written discourse of textbooks is formal, sometimes highly technical in nature and like much technical discourse, is multimodal, including a range of charts, tables, illustrations and so on, all of which the student has to learn to ‘read’. As one flight instructor noted, students ‘must have the English language skills to understand mathematical/scientific terms’ (Personal correspondence). Fortunately for the students, the content is expository and has been written with the express intent of imparting knowledge upon those new to the field. Today, to support the instructor and the textbook, aviation training is commonly augmented by e-learning which, again, often requires reading and listening skills. For example, on an integrated Airline Transport Pilot Licence programme which follows the European Aviation Safety Agency syllabus, students may spend up to eight hours in the classroom, five days a week for six months, learning the subject-matter and preparing for CAA examinations across 15 subjects, successful performance in which requires familiarity with written

multiple choice questions<sup>9</sup>. Many students who have English as a first language find the volume of learning challenging. As one ATC instructor commented, ‘Our courses are challenging and require self-study and revision outside the classroom environment’ (Personal correspondence). Achieving success when English is not your first language is a considerable achievement!

The US Federal Aviation Administration (FAA) flight training model is a little different. Classroom-based ground school is integrated more closely with practical flight training and students tend to get into the aircraft much earlier in their training programme. While this may appear to be an obvious safety issue, it is important to remember that the flight instructor handles all ATC communications and remains in command throughout the early stages of flight training. The most important thing for the student is to benefit from their time in the air which means understanding the instructor in the briefing room and in the cockpit as the student is guided through basic aircraft handling and manoeuvres. Obviously, it is crucial that students can understand the instructor’s commands once inside the aircraft, though this brings with it added complications of listening in a very noisy environment and the cognitive load associated with listening to and acting on complex instructions simultaneously and understanding expository commentary from the instructor. A steep turn in a Cessna 152 is no place for a misunderstanding to occur!

Given the considerable investment of time and cost associated with aviation training, neither the student, the student’s sponsor nor the ATO can afford for the student to fall behind and to bear the costs and disruption associated with repeat training or failure, or worse still, have a safety incident on account of poor English. As training begins, it’s crucial that the student has the right language skills at the right level of proficiency.

We have looked briefly at who the students are and the situations that they encounter on commencing aviation training, which we can broadly summarise as follows:

1. Students selected for English medium flight training:
  - a. Are young and highly motivated;
  - b. Are from a wide range of nationalities and first language backgrounds;
  - c. Vary in their level of English language proficiency;
  - d. Have received school-level education in STEM subjects; and
  - e. Know very little about aviation.
2. Students selected for English medium flight training need to:
  - a. Cope with life in an English speaking environment;
  - b. Cope with a new professional learning culture;
  - c. Interact with staff and other students at the training centre;
  - d. Listen to classroom lectures;
  - e. Interact with instructors in one-to-one and small group contexts;
  - f. Read multimodal technical training textbooks, articles and e-learning;

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<sup>9</sup> For example, see the course outline for CAE-Oxford Aviation Academy’s Integrated ATPL Programme (Oxford): <http://www.caeoaa.com/oxford/integrated-atpl-program/course-outline/#.VkgjAXbhAdV>

- g. Read and listen to multimodal technical e-learning; and
- h. Read multiple choice questions for national aviation authority examinations.

Dudley-Evans and St John (1998: 41) present the following as ‘core’ general academic language skills and study activities:

1. Listening to lectures.
2. Participating in supervisions, seminars and tutorials.
3. Reading textbooks, articles and other material.
4. Writing essays, examination answers, dissertations and reports.

Depending on the student’s training programme and the stage the student has reached in the training pathway, we can see that 1, 2 and 3 above are all highly relevant in the context of initial aviation training.

One important question to ask is whether English for aviation training is English for General Academic Purposes or English for Specific Academic Purposes. In other words, is successful initial aviation training dependent upon on generic academic language knowledge and skills which are common to transferrable across disciplines and learning contexts, or is aviation training substantially different from other disciplines in terms of texts, skills and forms? An answer to this question would lead to a more robust theoretical platform from which to develop training and assessment for entrants to aviation training. Research in this area is needed.

### **3. Language level and the CEFR**

Our final question concerns language proficiency level. If well-designed tests that meet the ICAO LPRs are inappropriate for entrants to English medium aviation training due to students’ lack of subject-matter knowledge and the fact the LPRs do not address the language knowledge and skills required to learn, then what is an appropriate level of language proficiency? In order to successfully learn, what level do students need to reach before starting English medium aviation training? This is a question that the organisation for which I work needed to answer. In order to do so, we turned to the Common European Framework of Reference (CEFR), an established framework ‘designed to provide a transparent, coherent and comprehensive basis for the elaboration of language syllabuses and curriculum guidelines, the design of teaching and learning materials, and the assessment of foreign language proficiency’ (Council of Europe, 2015). As much language assessment for entry to academic programmes in Europe is aligned to the CEFR, my colleagues and I conducted some exploratory research to help us understand if the CEFR could offer a useful guide to the language skills required for successful aviation training. In addition, if the CEFR did prove useful, we wanted to know what an appropriate entry level of language proficiency might be as a starting point for developing specific purpose assessment criteria.

#### **3.1. Methodology**

Today, it is widely accepted that collaboration with subject-matter expert informants has an important role to play in the development of training and assessment of

language for specific purposes (Elder, 1993; Jacoby and McNamara, 1999; Dudley-Evans and St John, 1998; Douglas, 2000, 2001; Hyland, 2006; Flowerdew and Peacock, 2001). Flowerdew and Peacock advise that ‘Given the technical nature of the areas of language use which EAP is concerned ... there is an important role to be played by the specialist informant, a subject-matter expert which can interpret the conceptual content of the target situation on behalf of the needs analyst’ (Flowerdew and Peacock, 2001:179). Furthermore, Knoch suggests that ‘using subject specialists’ judgments of language performance adds to the validity of the resulting assessment criteria’ (Knoch, 2014, p1). Thus, we decided to gather data from subject-matter expert informants by inviting theoretical training instructors from three well known providers of English medium flight and air traffic control training<sup>10</sup> to participate in a 25 minute paper-based questionnaire (Appendix A). In the questionnaire, we presented 11 communicative activities from the CEFR as shown in table 2:

Communicative activities		
Reception	Spoken	Understanding interaction between native speakers
		Understanding a native speaker
		Listening as a member of a live audience
		Listening to announcements & instructions
	Listening to radio and audio recordings	
	Audio-visual	Watching TV and film
Working with text	Text	Note-taking in seminars and lectures
Reception	Written	Reading correspondence
		Reading for orientation
		Reading for information & argument
		Reading instructions

Table 2. Selected CEFR communicative activities

The communicative activities were selected on the basis of the researchers’ intuitive judgements about ab-initio aviation training. Of course, successful aviation training is contingent upon proficiency in a broad range of language skills, though we wanted a narrow focus for our research activity for two reasons: Firstly we wanted to understand the skills which we felt students rely upon most heavily in the early days of aviation training, those which are connected to understanding the content of technical classroom instruction. Secondly, had we broadened the scope of the research to include a full range of abilities across the skills, the questionnaire would have become much longer and may have put our participants off. Therefore, we selected a range of communicative activities from the CEFR categories of *listening comprehension*, *reading comprehension*, and *working with text* while maintaining a focus on receptive skills in the classroom.

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<sup>10</sup> CAE-Oxford Aviation Academy (UK), National Air Traffic Services (UK) and Flight Safety International (USA).

The purpose of the questionnaire was a) to corroborate our view on the relevance of the selected communicative activities to initial aviation training and b) to find out expert judges' views as to which CEFR level of proficiency is required in each of these activities for the student to be considered ready to begin aviation training. Thus, each of the communicative activities was presented with the associated illustrative descriptors at CEFR levels A2, B1 and B2. The descriptors' CEFR levels were not revealed in the questionnaire.

The participants were asked to make two judgements: Firstly, to decide, with regard to initial aviation training, if the descriptors are a) relevant, b) partially relevant or c) irrelevant. Secondly, to decide if the descriptors apply to students who are:

- a) **Ready** for English medium aviation training, i.e. the student would be unlikely to encounter language related difficulties
- b) **Borderline**, i.e. the student may encounter language related difficulties
- c) **Not ready**, i.e. language is likely to present an obstacle to effective training

We chose the range of A2 to B2 for three reasons. Firstly, we felt that it was evident that A1 would be insufficient for professional aviation training. Secondly, if we presented higher levels - C1, C2 - the judges would naturally have been tempted to choose them. This may have inflated the perceived minimum entry level which may have the pragmatic effect of excluding many students who possibly have adequate language proficiency. Thirdly, as B2 is used as an entry level for much graduate and post-graduate education across Europe, we felt it was reasonable to expect that B2 would be a sufficient minimum for professional aviation training.

### 3.2. Results and discussion

The questionnaire responses were collected and the data were analysed firstly to determine the relevance of the selected language activities to aviation training. The results of this analysis can be seen in table 3. A strong majority decided that all the activities, with the exception of 'watching TV and film', were relevant to ab-initio aviation training.

The data regarding judgements on the illustrative descriptors were subject to a Many Facet Rasch Measurement<sup>11</sup> in order to analyse judge consistency and to account for judge severity. The first FACETS analysis revealed that four of the 14 judges were making unpredictable judgements, for example, deciding that a CEFR A1 describes students who are 'ready' for aviation training while at the same time deciding that another CEFR B2 descriptor describes students who are 'not ready'. These judges' data were removed from the dataset and the analysis was run a second time. The judge measurement report (appendix B) showed that 9 of the 10 remaining judges were making judgements within acceptable quality control parameters with Infit and Outfit Mean Square (MNSQ) values of between 0.5 and 1.5. Only one judge (judge 6) was performing at the edge of acceptability with an outfit MNSQ value of 1.59 though the outfit Zstd was within  $\pm 2$ . (Green, 2014) so her judgements were included.

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<sup>11</sup> MINIFAC, Linacre 2015



For the purposes of the analysis, judge responses were assigned a numerical value where ‘not ready’ was assigned a value of 1, ‘borderline’ a value of 2 and ‘ready’ a value of 3. Accordingly, fair average values of 1.00 to 1.63 were considered ‘not-ready’, 1.64 to 2.36 were considered ‘borderline’ and 2.37 to 3.00 were considered ‘ready’. Where fair average values were close to these approximate band thresholds, the fair average was compared to the strength of the mode. This comparison supported a definitive judgement.

CEFR Illustrative descriptor	Relevant	Partially relevant	Irrelevant
Understanding interaction between native speakers	N=12 (85.71%)	N=2 (14.28%)	
Understanding a native speaker	N=14 (100%)		
Listening as a member of a live audience	N=14 (100%)		
Listening to announcements & instructions	N=13 (92.85%)	N=1 (7.14%)	
Listening to radio and audio recordings	N=13 (92.85%)	N=1 (7.14%)	
Watching TV and film	N=7 (50%)	N=5 (35.71%)	N=2 (14.28%)
Note-taking in seminars and lectures	N=13 (92.85%)	N=1 (7.14%)	
Reading correspondence	N=10 (71.42%)	N=4 (28.57%)	
Reading for orientation	N=13 (92.85%)	N=1 (7.14%)	
Reading for information & argument	N=12 (85.71%)	N=2 (14.28%)	
Reading instructions	N=14 (100%)		

*Table 3. Judge perceptions of the relevance of selected CEFR language activities to aviation training*

The results from the second FACETS analysis showed that three illustrative descriptors (4, 8 and 30) had unacceptable quality control statistics with Infit and/or Outfit MNSQ values of <0.5 and/or greater than 1.5 with accompanying Zstd values

of  $\pm 2$  (Green, 2014). The data for these descriptors were removed from the dataset. The data for the remaining 50 descriptors were then analysed for the strength of correlation between judge perceptions of the readiness of students for aviation training and CEFR levels as shown in table 4.

		Judge perception		
		Not ready	Borderline	Ready
CEFR Level	A2	11	3	
	B1	3	11	5
	B2		1	16
		N=50		

Table 4. Correlation between judge perceptions of student readiness for aviation training and CEFR illustrative descriptors at levels A2-B2

The Spearman’s rho value for the data is 0.82361 with a two-tailed P value of 0 showing a statistically significant correlation between expert judgements and CEFR levels.

### 3.3. Discussion

The study was limited in that the number of judges was small. Furthermore, the questionnaire didn’t account for many of the language activities, strategies and competencies which are unarguably important for successful learning in the aviation academy, for example *spoken production* and *spoken interaction*, *communication strategies*, *working with text* and *communicative language competence*. Nevertheless, the study leads us to two important conclusions. Firstly, the CEFR contains descriptions of language use that aviation subject-matter expert judges consider to be relevant to ab-initio aviation training. Secondly, B2 on the CEFR can be considered a minimum entry level of language proficiency for English-medium aviation training.

### Conclusion

Given the forecasts for growth in the aviation industry, many young people around the world will enter dynamic, highly skilled and exciting careers as pilots and ATCOs in the years to come. Many of the next generation of aviation professionals will not have English as a first language, and so aviation English training and assessment practitioners are charged with the responsibility to investigate the needs of students and stakeholders in aviation training, and develop language training and tests that will meet those needs. This requires a shift in the emphasis of learning, teaching and assessment away from the ICAO LPRs and towards the language skills and competence that students require to successfully cope with their future learning

context. In order to provide engaging, meaningful and relevant teaching and to make our training and assessment useful for the stakeholders in ab-initio pilot and ATCO training, full and detailed needs analysis is called for. Any pursuit of such a goal would benefit from the principles of EAP and reference to the CEFR. As much as anything else, it is the purpose of this paper to present ab-initio aviation training as an area of EAP that requires urgent attention if we are to help learners to learn, to help improve the efficiency of aviation training and to support the aviation industry as it marches forward.

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## APPENDIX: Expert Judge Questionnaire

### Listening Comprehension

<b>1. UNDERSTANDING INTERACTION BETWEEN NATIVE SPEAKERS</b>	<b>This task is:</b>		
	<b>Relevant</b>	<input type="checkbox"/>	
	<b>Partially relevant</b>	<input type="checkbox"/>	
	<b>Irrelevant</b>	<input type="checkbox"/>	
	<b>Ready</b>	<b>Borderline</b>	<b>Not ready</b>
1. Can keep up with an animated conversation between native speakers.			
2. Can with some effort catch much of what is said around him/her, but may find it difficult to participate effectively in discussion with several native speakers who do not modify their language in any way.			
3. Can generally follow the main points of extended discussion around him/her, provided speech is clearly articulated in standard dialect.			
4. Can generally identify the topic of discussion around him/her that is conducted slowly and clearly.			
<b>2. UNDERSTANDING A NATIVE SPEAKER</b>	<b>This task is:</b>		
	<b>Relevant</b>	<input type="checkbox"/>	
	<b>Partially relevant</b>	<input type="checkbox"/>	
	<b>Irrelevant</b>	<input type="checkbox"/>	
	<b>Ready</b>	<b>Borderline</b>	<b>Not ready</b>
5. Can understand in detail what is said to him/her in the standard spoken language even in a noisy environment.			
6. Can follow clearly articulated speech directed at him/her in everyday conversation, though will sometimes have to ask for repetition of particular words and phrases.			
7. Can understand enough to manage simple, routine exchanges without undue effort.			
8. Can generally understand clear, standard speech on familiar matters directed at him/her, provided he/she can ask for repetition or reformulation from time to time.			
	<b>This task is:</b>		

	Relevant	<input type="checkbox"/>	
	Partially relevant	<input type="checkbox"/>	
	Irrelevant	<input type="checkbox"/>	
	Ready	Borderline	Not ready
9.Can follow the essentials of lectures, talks and reports and other forms of academic/professional presentation which are propositionally and linguistically complex.			
10.Can follow a lecture or talk within his/her own field, provided the subject-matter is familiar and the presentation straightforward and clearly structured.			
11.Can follow in outline straightforward short talks on familiar topics provided these are delivered in clearly articulated standard speech.			
<b>4.LISTENING TO ANNOUNCEMENTS &amp; INSTRUCTIONS</b>	This task is:		
	Relevant	<input type="checkbox"/>	
	Partially relevant	<input type="checkbox"/>	
	Irrelevant	<input type="checkbox"/>	
	Ready	Borderline	Not ready
12.Can understand announcements and messages on concrete and abstract topics spoken in standard dialect at normal speed.			
13.Can understand simple technical information, such as operating instructions for everyday equipment.			
14.Can follow detailed directions.			
15.Can catch the main point in short, clear, simple messages and announcements.			
16.Can understand simple directions relating to how to get from to Y, by foot or public transport.			
<b>5. LISTENING TO RADIO AUDIO &amp; RECORDINGS</b>	This task is:		
	Relevant	<input type="checkbox"/>	
	Partially relevant	<input type="checkbox"/>	
	Irrelevant	<input type="checkbox"/>	
	Ready	Borderline	Not ready
17.Can understand recordings in standard dialect likely to be encountered in social, professional or academic life and identify speaker viewpoints and attitudes as well as the			

information content.			
18.Can understand most radio documentaries and most other recorded or broadcast audio material delivered in standard dialect and can identify the speaker's mood, tone etc.			
19.Can understand the information content of the majority of recorded or broadcast audio material on topics of personal interest delivered in clear standard speech.			
20.Can understand the main points of radio news bulletins and simpler recorded material about familiar subjects delivered relatively slowly and clearly.			
21.Can understand and extract the essential information from short recorded passages dealing with predictable everyday matters that are delivered slowly and clearly.			
<b>6. WATCHING TV AND FILM</b>	<b>This task is:</b>		
	<b>Relevant</b>	<input type="checkbox"/>	
	<b>Partially relevant</b>	<input type="checkbox"/>	
	<b>Irrelevant</b>	<input type="checkbox"/>	
	<b>Ready</b>	<b>Borderline</b>	<b>Not ready</b>
22.Can understand most TV news and current affairs programmes.			
23.Can understand documentaries, live interviews, talk shows, plays and the majority of films in standard dialect.			
24.Can understand a large part of many TV programmes on topics of personal interest such as interviews, short lectures, and news reports when the delivery is relatively slow and clear.			
25.Can follow many films in which visuals and action carry much of the storyline, and which are delivered clearly in straightforward language.			
26.Can catch the main points in TV programmes on familiar topics when the delivery is relatively slow and clear.			
27.Can identify the main point of TV news items reporting events, accidents etc. where the visual supports the commentary.			

28.Can follow changes of topic of factual TV news items, and form an idea of the main content.			
<b>7. NOTE-TAKING (LECTURES, SEMINARS, ETC.)</b>	<b>This task is:</b>		
	<b>Relevant</b>	<input type="checkbox"/>	
	<b>Partially relevant</b>	<input type="checkbox"/>	
	<b>Irrelevant</b>	<input type="checkbox"/>	
	<b>Ready</b>	<b>Borderline</b>	<b>Not ready</b>
29.Can understand a clearly structured lecture on a familiar subject, and can take notes on points which strike him/her as important, even though he/she tends to concentrate on the words themselves and therefore to miss some information.			
30.Can take notes during a lecture, which are precise enough for his/her own use at a later date, provided the topic is within his/her field of interest and the talk is clear and well structured.			
31.Can take notes as a list of key points during a straightforward lecture, provided the topic is familiar, and the talk is both formulated in simple language and delivered in clearly articulated standard speech.			

### Reading Comprehension

<b>8. READING CORRESPONDENCE</b>	<b>This task is:</b>		
	<b>Relevant</b>	<input type="checkbox"/>	
	<b>Partially relevant</b>	<input type="checkbox"/>	
	<b>Irrelevant</b>	<input type="checkbox"/>	
	<b>Ready</b>	<b>Borderline</b>	<b>Not ready</b>
32.Can read correspondence relating to his/her field of interest and readily grasp the essential meaning.			
33.Can understand the description of events, feelings and wishes in personal letters well enough to correspond regularly with a pen friend.			
34.Can understand basic types of standard routine letters and faxes (enquiries, orders, letters of confirmation etc.) on familiar topics			



35.Can understand short simple personal letters.			
<b>9. READING FOR ORIENTATION</b>	<b>This task is:</b>		
	<b>Relevant</b>	<input type="checkbox"/>	
	<b>Partially relevant</b>	<input type="checkbox"/>	
	<b>Irrelevant</b>	<input type="checkbox"/>	
	<b>Ready</b>	<b>Borderline</b>	<b>Not ready</b>
36.Can scan quickly through long and complex texts, locating relevant details.			
37.Can quickly identify the content and relevance of news items, articles and reports on a wide range of professional topics, deciding whether closer study is worthwhile.			
38.Can scan longer texts in order to locate desired information, and gather information from different parts of a text, or from different texts in order to fulfil a specific task.			
39.Can find and understand relevant information in everyday material, such as letters, brochures and short official documents.			
40.Can find specific, predictable information in simple everyday material such as advertisements, prospectuses, menus, reference lists and timetables.			
41.Can locate specific information in lists and isolate the information required (e.g. use the "Yellow Pages" to find a service or tradesman).			
42.Can understand everyday signs and notices: in public places, such as streets, restaurants, railway stations; in workplaces, such as directions, instructions, hazard warnings.			
<b>10. READING FOR INFORMATION &amp; ARGUMENT</b>	<b>This task is:</b>		
	<b>Relevant</b>	<input type="checkbox"/>	
	<b>Partially relevant</b>	<input type="checkbox"/>	
	<b>Irrelevant</b>	<input type="checkbox"/>	
	<b>Ready</b>	<b>Borderline</b>	<b>Not ready</b>
43.Can obtain information, ideas and opinions from highly specialised sources within his/her field.			

44.Can understand specialised articles outside his/her field, provided he/she can use a dictionary occasionally to confirm his/her interpretation of terminology.			
45.Can understand articles and reports concerned with contemporary problems in which the writers adopt particular stances or viewpoints.			
46.Can identify the main conclusions in clearly signalled argumentative texts.			
47.Can recognise the line of argument in the treatment of the issue presented, though not necessarily in detail.			
48.Can recognise significant points in straightforward newspaper articles on familiar subjects.			
49.Can identify specific information in simpler written material he/she encounters such as letters, brochures and short newspaper articles describing events.			
<b>11. READING INSTRUCTIONS</b>	<b>This task is:</b>		
	<b>Relevant</b>	<input type="checkbox"/>	
	<b>Partially relevant</b>	<input type="checkbox"/>	
	<b>Irrelevant</b>	<input type="checkbox"/>	
	<b>Ready</b>	<b>Borderline</b>	<b>Not ready</b>
50.Can understand lengthy, complex instructions in his field, including details on conditions and warnings, provided he/she can reread difficult sections.			
51.Can understand clearly written, straightforward instructions for a piece of equipment.			
52.Can understand regulations, for example safety, when expressed in simple language.			
53.Can understand simple instructions on equipment encountered in everyday life - such as a public telephone.			

## Other skills/tasks

Are there any other language tasks/skills which you think are essential for initial aviation training? If 'yes', please give details in the space below.

**APPENDIX B: FACETS Judge Measurement Report**

Total Score	Total Count	Obsvd Average	Fair(M) Average	Model Measure	Infit S.E.	Outfit MnSq	Outfit ZStd	Estim. MnSq	Correlation PtMea	Correlation PtExp	Nu	l	Judge
136	53	2.57	2.73	2.64	.37	.91	-.3	.62	.0	1.13	.74	.73	4 4
135	53	2.55	2.70	2.50	.37	.89	-.3	.61	.0	1.14	.75	.73	5 5
133	53	2.51	2.64	2.24	.36	1.09	.4	1.16	.4	.81	.74	.75	1 1
114	53	2.15	2.07	-.02	.34	1.14	.6	1.59	1.6	.79	.83	.85	6 6
112	53	2.11	2.02	-.25	.34	.63	-1.8	.50	-1.8	1.42	.91	.86	8 8
109	53	2.06	1.95	-.60	.34	1.37	1.5	1.14	.5	.67	.83	.87	9 9
108	53	2.04	1.92	-.72	.34	.93	-.2	.82	-.5	1.09	.88	.87	14 14
105	53	1.98	1.84	-1.07	.34	.69	-1.5	.57	-1.5	1.35	.91	.87	7 7
98	53	1.85	1.63	-1.91	.35	.95	-.1	.70	-.6	1.12	.89	.87	10 10
91	53	1.72	1.40	-2.80	.37	1.20	.9	1.19	.4	.73	.84	.86	13 13
114.1	53.0	2.15	2.09	.00	.35	.98	-.1	.89	-.2		.83		Mean (Count: 10)
14.9	.0	.28	.43	1.78	.01	.21	1.0	.34	1.0		.07		S.D. (Population)
15.7	.0	.30	.46	1.88	.01	.23	1.1	.36	1.0		.07		S.D. (Sample)
Model, Populn: RMSE .35 Adj (True) S.D. 1.75 Separation 4.94 Strata 6.92 Reliability .96													
Model, Sample: RMSE .35 Adj (True) S.D. 1.84 Separation 5.22 Strata 7.29 Reliability .96													
Model, Fixed (all same) chi-square: 240.0 d.f.: 9 significance (probability): .00													
Model, Random (normal) chi-square: 8.7 d.f.: 8 significance (probability): .37													

Table 5.1.1 1 Judge Measurement Report (arranged by mN).

## APPENDIX C: FACETS Descriptor Measurement Report

Total Score	Total Count	Obsvd Average	Fair(M) Average	Model Measure	Model S.E.	Infit MnSq	Infit ZStd	Outfit MnSq	Outfit ZStd	Estim. Discrnm	Correlation PtMea	PtExp	Nu 2	Descriptor
30	10	3.00	2.99	6.58	1.90	Maximum					.00	.00	5	5
30	10	3.00	2.99	6.58	1.90	Maximum					.00	.00	9	9
30	10	3.00	2.99	6.58	1.90	Maximum					.00	.00	17	17
30	10	3.00	2.99	6.58	1.90	Maximum					.00	.00	36	36
30	10	3.00	2.99	6.58	1.90	Maximum					.00	.00	43	43
30	10	3.00	2.99	6.58	1.90	Maximum					.00	.00	50	50
29	10	2.90	2.96	5.16	1.14	1.52	.8	2.43	1.3	.42	.00	.37	1	1
29	10	2.90	2.96	5.16	1.14	.54	-.4	.20	.5	1.36	.52	.37	22	22
29	10	2.90	2.96	5.16	1.14	.54	-.4	.20	.5	1.36	.52	.37	23	23
29	10	2.90	2.96	5.16	1.14	.54	-.4	.20	.5	1.36	.52	.37	32	32
29	10	2.90	2.96	5.16	1.14	1.04	.3	.45	.7	1.06	.36	.37	37	37
29	10	2.90	2.96	5.16	1.14	.54	-.4	.20	.5	1.36	.52	.37	44	44
28	10	2.80	2.90	4.16	.89	.88	.0	.67	.3	1.11	.48	.48	12	12
28	10	2.80	2.90	4.16	.89	.76	-.3	.48	.2	1.27	.54	.48	29	29
28	10	2.80	2.90	4.16	.89	1.23	.5	.79	.4	.85	.37	.48	38	38
28	10	2.80	2.90	4.16	.89	.45	-1.1	.26	.0	1.55	.66	.48	51	51
27	10	2.70	2.81	3.45	.79	.92	.0	.63	.0	1.15	.55	.56	18	18
27	10	2.70	2.81	3.45	.79	.60	-.8	.43	-.1	1.48	.66	.56	33	33
27	10	2.70	2.81	3.45	.79	.60	-.8	.43	-.1	1.48	.66	.56	45	45
26	10	2.60	2.70	2.86	.74	1.88	1.8	3.29	1.8	-.36	.37	.61	30	30
25	10	2.50	2.57	2.33	.72	.67	-.7	.51	-.5	1.40	.70	.65	46	46
24	10	2.40	2.44	1.82	.71	1.92	1.6	1.54	.9	.10	.42	.69	14	14
23	10	2.30	2.31	1.33	.70	1.66	1.2	1.68	1.2	.39	.46	.71	2	2
22	10	2.20	2.19	.85	.68	1.49	1.0	1.58	1.1	.44	.05	.72	6	6
22	10	2.20	2.19	.85	.68	1.04	.2	1.00	.1	.98	.64	.72	39	39
21	10	2.10	2.09	.40	.67	.67	-.6	.68	-.6	1.36	.86	.71	19	19
21	10	2.10	2.09	.40	.67	.40	-1.6	.37	-1.6	1.67	.97	.71	47	47
20	10	2.00	1.99	-.03	.65	.79	-.4	.81	-.3	1.26	.73	.71	10	10
20	10	2.00	1.99	-.03	.65	.80	-.4	.79	-.4	1.21	.00	.71	13	13
20	10	2.00	1.99	-.03	.65	1.17	.5	1.17	.5	.72	.28	.71	24	24
20	10	2.00	1.99	-.03	.65	1.16	.5	1.19	.5	.82	.76	.71	34	34
20	10	2.00	1.99	-.03	.65	.79	-.4	.78	-.4	1.25	.52	.71	52	52
19	10	1.90	1.90	-.44	.64	.73	-.6	.70	-.7	1.41	.64	.70	31	31
18	10	1.80	1.81	-.85	.64	1.15	.5	1.31	.9	.71	.71	.69	40	40
17	10	1.70	1.71	-1.26	.65	.72	-.7	.67	-.8	1.46	.58	.69	3	3
17	10	1.70	1.71	-1.26	.65	.48	-1.7	.45	-1.6	1.82	.71	.69	25	25
17	10	1.70	1.71	-1.26	.65	.98	.0	.90	-.1	1.13	.85	.69	48	48
16	10	1.60	1.59	-1.70	.68	1.09	.3	.98	.1	.98	.86	.69	41	41
15	10	1.50	1.46	-2.19	.72	1.76	1.4	1.52	.9	.27	.52	.69	16	16
15	10	1.50	1.46	-2.19	.72	.74	-.4	.65	-.4	1.28	.68	.69	26	26
15	10	1.50	1.46	-2.19	.72	1.09	.3	2.56	1.9	.62	.39	.69	28	28
15	10	1.50	1.46	-2.19	.72	1.20	.5	1.04	.2	.88	.87	.69	42	42
14	10	1.40	1.32	-2.75	.79	.95	.0	.71	-.1	1.09	.81	.69	7	7
14	10	1.40	1.32	-2.75	.79	.55	-.7	.52	-.4	1.36	.78	.69	11	11
14	10	1.40	1.32	-2.75	.79	.57	-.6	.57	-.3	1.33	.76	.69	20	20
14	10	1.40	1.32	-2.75	.79	.57	-.6	.57	-.3	1.33	.76	.69	21	21
14	10	1.40	1.32	-2.75	.79	.41	-1.1	.33	-.8	1.49	.84	.69	35	35
13	10	1.30	1.19	-3.44	.87	3.54	2.7	2.74	1.4	-.65	.19	.67	4	4
13	10	1.30	1.19	-3.44	.87	.18	-1.8	.14	-.8	1.61	.90	.67	15	15
13	10	1.30	1.19	-3.44	.87	.18	-1.8	.14	-.8	1.61	.90	.67	49	49
13	10	1.30	1.19	-3.44	.87	.18	-1.8	.14	-.8	1.61	.90	.67	53	53
12	10	1.20	1.09	-4.26	.95	2.67	2.2	1.13	.6	-.09	.42	.59	8	8
12	10	1.20	1.09	-4.26	.95	1.61	1.1	1.35	.7	.48	.31	.59	27	27
21.5	10.0	2.15	2.15	1.07	.93	.98	-.1	.89	.1		.52			Mean (Count: 53)
6.3	.0	.63	.68	3.46	.38	.63	1.1	.70	.8		.29			S.D. (Population)
6.4	.0	.64	.69	3.49	.38	.64	1.1	.71	.8		.29			S.D. (Sample)
With extremes, Model, Populn: RMSE 1.00 Adj (True) S.D. 3.31 Separation 3.31 Strata 4.75 Reliability .92														
With extremes, Model, Sample: RMSE 1.00 Adj (True) S.D. 3.34 Separation 3.34 Strata 4.79 Reliability .92														
Without extremes, Model, Populn: RMSE .82 Adj (True) S.D. 2.90 Separation 3.55 Strata 5.07 Reliability .93														
Without extremes, Model, Sample: RMSE .82 Adj (True) S.D. 2.94 Separation 3.59 Strata 5.13 Reliability .93														
With extremes, Model, Fixed (all same) chi-square: 596.9 d.f.: 52 significance (probability): .00														
With extremes, Model, Random (normal) chi-square: 49.8 d.f.: 51 significance (probability): .52														

Table 5.2.1 2 Descriptor Measurement Report (arranged by mN).