INCREASING AVIATION SAFETY BY ASSESSING ENGLISH LANGUAGE PROFICIENCY AMONG AVIATION PROFESSIONALS

Hinnerk Eißfeldt
DLR German Aerospace Center

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Abstract

In aviation English has been agreed upon being the international working language ever since. However only less than 15% of the worlds population speaks English as mother tongue, and it seems reasonable to assume that among pilots and controllers the percentage of native speakers is below 30%.

To secure high global standards the International Civil Aviation Organisation (ICAO) in 2003 has defined new requirements concerning the level of English language proficiency among aviation professionals. From March 2008 on aviation professionals worldwide have to be assessed concerning their proficiency in speaking and listening preferably in aviation-specific context. ICAO proposes to start formal evaluation much earlier to assure applicants to meet language proficiency requirements as a prerequisite for recruitment. However by now no validated tools to achieve this have been published. This article offers a solution derived from the experience of the German Aerospace Center DLR to test English language skills among applicants for aviation careers, for example pilots, air traffic controllers or even astronauts.

1 ICAO Language Proficiency Requirements

In 1951 the International Civil Aviation Organisation ICAO reached a decision supported by all member states that "pending the development and adoption of a more suitable form of speech for universal use in aeronautical radiotelephony communications, the English language should be used as such and should be available on request" (ICAO recommendation 5.2.1.1.2). Detailed phraseology was developed thereafter to avoid miscommunication between partners in radio communication. However this did not prevent communication to play a significant role in incidents or accidents (for a listing see [1]). Tenerife in 1977 (583 †) and Avianca052 in 1990 (73†) are the most prominent examples for the deadliness of deficient language skills in aviation. According to ICAO "between 1976 and 2000 more than 1.100 passengers and crew lost their lives in accidents in which investigators determined that language had played a contributory role" [2].

Detailed safety analyses have revealed that the proper use of predefined ATC phraseology is not always sufficient. Thus in 2003 ICAO has released amendments to annexes of its Chicago Convention requiring aviation professionals involved in international operations to demonstrate a certain level of English language proficiency. As ICAO now states in special circumstances pilots and controllers must be able to express themselves in plain language.

Annex 10 describes what language(s) shall be used for radiotelephony communication: the language of the ground station or English. This means that proficiency in ICAO phraseology and plain English is required. Annex 6 and 11 establish that all personnel (pilots and air traffic controllers) comply with the ICAO language proficiency requirements stipulated in Annex 1. Annex 1 describes the language proficiency and testing requirements and contains a rating scale with six proficiency levels. Table 1 lists the proficiency levels defined by ICAO and the amount of retesting necessary.

Table 1 English language proficiency levels defined by ICAO

Level 6 (Expert)	will not be required to demonstrate subsequent language proficiency.
Level 5 (Extended)	will need to be retested every six years.
Level 4 (Operational)	will need to be retested every three years.
Level 3 (Pre-operational)	or below:
Level 2 (Elementary)	will need specific Aviation English language training
Level 1 (Pre-elementary)	to reach the minimum ICAO level, Operational.

The minimum language proficiency is defined at ICAO Level 4 (Operational) as a licensing requirement. Table 2 describes the rating scale at this level. Although these standards became applicable in November 2003, all ICAO member states have been given until March 2008 to fulfill the necessary training requirements to allow personnel to meet mandatory testing and licensing requirements [3]. States not in compliance with the new licensing requirements will be requested to notify ICAO, which may limit international recognition of licenses.

Table 2 ICAO language proficiency rating scale (Operational Level 4)

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

2 Testing of English language skills

English language testing has always been part of DLR's test system. A standard test battery for pilots or air traffic controllers for example to our mind has to contain a written test of English (grammar, vocabulary, meaning) in a multiple-choice format to be applied in groups of up to 50 candidates in the first stage of selection (a more detailed description of the selection system is provided by [4]). Under special circumstances even more than one test has to be used at this stage to include an early assessment of the ability to understand spoken information.

For candidates reaching the second stage of selection their actual English skill has to be assessed on an individual base either in a special oral examination or during the interview (e.g. if this is to be done in English anyhow). If the candidate applies for a job in a multinational team with English being the working language, also native speakers shall be assessed regarding language skills as the intelligibility of their voice output might be restricted due to strong dialect. Problems of dialect and pronunciation are also reasons why ICAO demands aviation professionals to be assessed in their national language too.

With the new ICAO requirements for training providers it will be very important to assess the proper level of English language prior to the start of training, as according to the new regulations insufficient language skills will terminate training of any applicant regardless of all other achievements. In the following it is described how English language proficiency can be assessed among ab-initio applicants using existing DLR tests.

2.1 English Listening Test ENL

The English Listening Test "ENL" was developed in 1993, when the German Aerospace Center DLR was in charge of the selection of international air traffic controller applicants for EUROCONTROL. At that time tests in use concerning English language skills used either written items of multiple-choice format or spoken English items, for instances vocabulary that had to be translated in writing or numbers that had to be written down. This required a lot of manpower as it did not allow for machine based scoring techniques. In addition after seeing applicants in the interview the impression occurred that although test scores have been at level for some applicants the language competence to conduct an interview in plain English was rather restricted. To avoid a waste of time in the selection process the ENL should measure the understanding of complex meaning on the basis of spoken English language and allow for machine scored group testing.

The test offers pure acoustic items in English language presented via headset to work on. Some of the items refer to aviation to increase the applicant's motivation. To control the impact of mother tongue in the sample, all relevant steps of test development were performed twice, including or excluding native speakers.

The test consists of four different parts. Each of the four parts of the test assesses English listening comprehension in a different format. All parts require to listen to acoustic information first. Then four alternatives are presented to choose the correct answer. The time to choose one of the four answers is restricted.

The four parts are:

1) **Simple Meaning** (12 Items). A sentence is read and the test taker needs to find out which of the four given options presents the sentence that is closest in meaning to the one heard.
2) **Numbers** (10 Items). sentence including a number is read and the test taker has to choose the number mentioned in the sentence from four answers offered.
3) **Vocabulary** (12 Items). A sentence is read and one of the words is marked by a preceding beep. The test taker has to choose out of four options a word that is closest in meaning to a certain word that was read in the sentence.

4) **Complex Meaning** (12 Items). A short story of about 100 words is read and questions relating to the story are presented. The test taker has to choose the correct answer from alternatives offered

The test administration itself is fully computerised. The test taker has to click with the mouse onto the frame that contains the correct response or put a finger on the touch screen accordingly. A test administrator is needed in order to introduce the test taker and to monitor the testing process. In particular, disturbing noise has to be prevented and it is not allowed to take notes during the test or to refer to dictionaries. The scoring procedures are fully computerised and the test is evaluated automatically. In a special application the ENL is administered and evaluated via internet.

ENL results are reliable: Cronbach's α for the computerised test version of the test was 0.89 (n = 194) in a study conducted with European ATC applicants in 2000. Construct validity is proven by the correlation of the ENL total score with the result of a written English test (ENS, English written) with r = 0.80, p<.000, n = 403. After exclusion of native speakers (Origin: Great Britain) the correlation was r = 0.76, p<.000, n = 341. ENL and ENS were both administered at the same testing session (pre-selection stage) at different times of the day.

To assess predictive validity ENL test results were used to predict results of English oral examination, which was done several weeks after the first stage. At the end of the second testing stage (main selection) an oral interview was conducted by the interview board with applicants having passed all other tests. Directly after the interview, five selection board members rated the applicants' oral performance in English in a quasi-Stanine scale. The average of those ratings forms the final score for oral English ENM. The correlation of ENL total score and ENM was r = 0.69 (p<.000, n = 109). Excluding native speakers (origin: Great Britain) the correlation of ENL with ENM was r = 0.66 (p<.000, n = 93) in a sample comprising 21 different European nations.

2.2 Standard oral examination

The standard oral examination at DLR is developed for non-native speakers. It is performed in a standardized manner using special item material and defined measurements. The candidates have 15 minutes to read a text of about one page length to prepare for the examination. They then have to read it aloud in front of the board, retell the story in their own words and answer some questions. In the second part candidates are free to choose among different types of items: pictures, cartoons (picture stories) or general statements to be used as basis for interaction in free speech.

Usually the oral examination is performed by job incumbents after having received a special training as for instance in the selection of ab-initio air traffic controllers for DFS Deutsche Flugsicherung GmbH. Criteria to be rated are pronunciation, grammar, vocabulary and comprehension. Every criterion is described by 3-4 anchored subscales on a standard rating form. As Stanine scales are used throughout the selection process, the overall rating as well as the criteria are measured on a quasi-stanine scale. Figure 1 shows the distribution of results for N = 660 candidates.

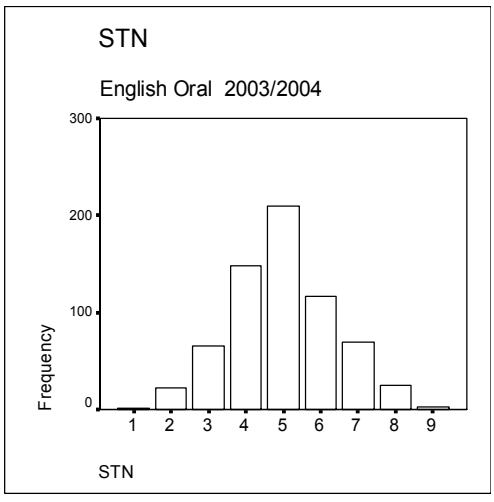

Fig. 1 Results of English oral examination, N = 660

Interrater correlations rank from r = .72 to r = .85 for the criteria and r = .89 (all p<.000, N = 660) for the overall English oral stanine score.

In the context of selection of controllers for DFS the English oral examination is of special importance as for candidates receiving a result just below the required level a special option is available. Provided that all other test results (cognitive testing, work sample tests, assessment center and interview) are at or above the defined level of acceptance and the candidate would be recommended for training course otherwise, he/she can retake the English oral after some additional training of within half a year. It then depends on the initiative of the candidate to improve his/her English on his own costs. More than 80% of candidates retaking the English oral are finally successful and enter ATC training. Their success rate in institutional as well as in practical training is the same compared to trainees without special additional language course.

3 English language competence and training success

The predictive power of English language test performance has been assessed in different validation studies at DLR. Usually test results in English show close correlation not only with English grades at school but with school grades in general. In a detailed study the general mental ability 'g' was computed for N = 2954 air traffic control applicants using the various test results in selection (see [5] for details). When 'g' was correlated with the results from each single test, results indicated a strong connection between 'general mental ability' and foreign language skill (r = .40, p<.000). Furthermore in a national validation study with ATC trainees English appeared to be among the best predictors of theoretical training at the academy as well of the simulator checks [6]. Although some of the content of training is presented in English strong correlations have also been found for examinations not related to foreign language. Similar findings occurred in a validation study with ab-initio pilots in Asia. Thus a solid level of English language proficiency as it is required in ICAO Level 4 will not only increase aviation safety but also has the potential to reduce failure rates in training among ab-initios.

Using the proposed DLR tests can be of great help assessing English language proficiency as they are easy to administer and have been successfully applied in aviation for many years. Providing norms reflecting international samples can be of major advantage when ICAO intends to guarantee the same language criteria to be used across all Member States. A first measure by ICAO to allow international comparison is to offer rated speech samples reflecting the proficiency levels 3, 4, and 5 on CD-ROM [7].

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