

# THE RELATIONSHIP OF THE BARB AND NPS TESTS TO OTHER UK SERVICE SELECTION TESTS

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## INTRODUCTION

One of the recommendations from a series of Defence Cost Studies recently conducted in the UK was that consideration should be given to the establishment of a single initial selection test for tri-service rating/other rank use. As well as providing economies in terms of future test development, maintenance and validation, this recommendation was particularly pertinent given the age of the existing Royal Navy (RN) and Royal Air Force (RAF) batteries and the considerable cost of renewing these. The Selection Testing Working Group (STWG) was re-formed to investigate the potential of establishing a single tri-service test and has commissioned a number of studies to look at the inter-relationship of the different service selection batteries.

This paper draws upon the findings from a series of studies sponsored by the STWG. It looks at the relationship between the BARB and NPS tests and existing UK: service selection tests. The studies provide insights into the construct validity of the BARB and NPS batteries and the scope for rationalising initial selection testing.

## THE BARB AND NPS BATTERIES

The British Army Recruit Battery (BARB) is the British Army's initial selection test. It has been in service since 1992. Computer based, the test uses item-generation theory to generate and deliver a unique set of items to each candidate. Interaction with the computer is by a touch-sensitive monitor. The battery currently consists of six scored sub-tests, five of which are simple cognitive tasks that map onto Carroll's second order psychometric constructs and ultimately contribute to the third order factor of general intelligence (Carroll, 1993). The sixth test, a vocabulary task, does not share the same theoretical underpinning, but can be viewed as mapping onto Carroll's second order construct of crystallised intelligence. A composite score referred to as the GTI is the main output from the battery.

The NPS battery is a pencil- and paper-based experimental battery developed for evaluation by the Royal Navy. It consists of two main parts: the ABC tests and the numeracy & literacy tests. The ABC tests consist of five subtests which share the same theoretical basis as the BARB sub-tests (four of the five tests have very similar item types). The ABC tests are supplemented by the numeracy and literacy tests. These do not share the same conceptual basis as the ABC tests, but as with the BARB vocabulary task, would appear to load onto the crystallised intelligence factor. A composite score referred to as NPS Total is the main output from the battery, although a separate composite, the ABC total, is computed from the ABC tests. The sub-tests and the overlap between the BARB and NPS batteries are illustrated in Figure 1.

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## OTHER SERVICE TEST BATTERIES

The current RN test battery is called the Recruiting Test (RT). The RAF battery is called the Ground Trades Test Battery (GTTB). The two batteries have been in service, with revisions, since the 1940/1950s. The theoretical basis of the batteries can be traced to Spearman's seminal work on the structure of the intellect (Spearman, 1927). Each of the batteries consist of four sub-tests measuring general intelligence through Spearman's verbal education and spatial/mechanical factors. The GTTB contains an additional two attainment-loaded tests for technician selection; these are taken by only a proportion of RAF applicants. The composite score from the RT is referred to as the RT Total. The GTTB produces two composites: the GM, formed from the four subtests measuring general intelligence, and the GTI, formed from the GAI and the attainment-loaded technician tests.



*Figure 1. The interrelationship of the BARB and NPS test batteries*

## CONTRIBUTING STUDIES

A number of studies were commissioned by the STWG. In these studies, applicants/entrants from each of the services sat a further test battery in addition to the one they had taken for selection. The studies which are reviewed in this paper are:

- BARB vs GTTB (Kitson & Elshaw, 1996)
- NPS vs GTTB (Bailey, 1996)
- NPS vs RT (Jones, Dennis & Collis, 1995) and
- BARB vs NPS ABC (Price et al., 1996)

### BARB vs GTTB

In this study, a sample of 428 army applicants took the GTTB whilst attending a Recruit Selection Centre. All applicants had previously taken BARB as part of the selection process. The delay between taking BARB and GTTB was approximately one month. Analysis of the data produced a correlation between BARB GTI and GTTB GAI of 0.66.

When corrected for the unreliability of the two tests, a correlation of 0.77 was obtained.

**Table 1 shows the correlation matrix for the BARB and GTTB subtests.**

<b>GTTB</b>	<b>BARB</b>					
<b>RAF GTTB</b>	<b>Alphabet F/B</b>	<b>Letter Checking</b>	<b>Number Distance</b>	<b>Symbol Rotation</b>	<b>Synonyms /Antonyms</b>	<b>Transitive Inference</b>
G6 Reasoning	0.32	0.31	0.45	0.31	0.55	0.46
G7 Non-Ver Reasoning	0.26	0.27	0.44	0.38	0.40	0.30
N7 Arithmetic	0.24	0.24	0.50	0.31	0.36	0.33
V5 Word Knowledge	0.32	0.27	0.31	0.24	0.61	0.38

All correlations  $p < 0.01$

*Table 1. Table showing BARB and GTTB subtest intercorrelations*

The correlations shown in the table range from low to good. Some of the correlations are encouraging and provide evidence to support the construct validity of some of the BARB tests (e.g., number distance and arithmetic, synonyms/antonyms and word knowledge, etc.). A factor analysis of the combined subtests, including the two GTTB attainment loaded tests, yielded a two factor solution. The core BARB tests and three of the GTTB core tests (excluding word knowledge) loaded onto the first factor. The second factor comprised the BARB synonyms/antonyms test, the GTTB word knowledge test, and the GTTB attainment-loaded tests. These results indicate that both batteries are measuring a common g factor as well as slightly more VEd/crystallised g factor.

### **NPS vs GTTB**

In this study, 384 RAF recruits in basic training took the NPS battery of tests. All the recruits had previously taken the GTTB as part of their selection into the RAF. The delay between taking the GTTB and NPS is believed to be up to several months. Correlations between GTTB, GAI, and NPS total and ABC total were calculated to be 0.66 and 0.60, respectively (0.77 and 0.71 when corrected for unreliability). The correlation matrix for the GTTB and NPS subtests is shown in **Table 2**.

NPS/ABC							
GTTB	Letter Distance	Letter Checking	Number Distance	Symbol Rotation	Reasoning	Literacy	Numeracy
G6 Reasoning	0.38	0.34	0.49	0.35	0.39	0.45	0.61
G7 Non-Ver Reasoning	0.32	0.36	0.40	0.41	0.33	0.30	0.40
N7 Arithmetic	0.41	0.35	0.50	0.30	0.38	0.38	0.68
V5 Word Knowledge	0.25	0.20	0.26	0.05 <sup>+</sup>	0.25	0.66	0.39
E1 Elec Knowledge	0.06 <sup>+</sup>	0.14	0.25	0.30	0.21	0.33	0.41
M2 Craft Knowledge	0.06 <sup>+</sup>	0.08 <sup>+</sup>	0.12 <sup>*</sup>	0.20	0.13 <sup>*</sup>	0.33	0.29

<sup>+</sup>Not significant \* $p < 0.05$  All other correlations  $p < 0.01$

Table 2. Table showing GTTB and NPS subtest intercorrelations

Once again, the correlations shown in the table range from low to high. The pattern of correlations is much as anticipated and provides evidence for the construct validity of the NPS battery. A factor analysis was undertaken, which yielded a three-factor solution. The majority of the subtests loaded onto the first factor. The two attainment-loaded technician tests formed the second factor, and the third factor comprised the NPS literacy test and the GTTB word knowledge test.

### NPS vs RT

In this study, the findings from the analysis of data from 1,988 RN applicants who sat the NPS battery are reported. The applicants sat the NPS battery approximately one week after sitting the RT. Correlations between ABC total and NPS total with RT Total of 0.59 and 0.67 were obtained (corrected correlations 0.70 and 0.78 respectively). Subtest correlations are shown in Table 3. Again, these range from low to high and once again their pattern generally supports the construct validity of the NPS battery. A factor analysis of the combined batteries produced a four-factor solution, with only the first three factors being readily interpretable. The ABC tests and the two numeracy tests loaded onto the first factor. The two literacy tests loaded onto the second factor, and the symbol rotation and mechanical comprehension tests loaded onto the third factor.

	NPS						
	ABC						
RT	Letter Distance	Letter Checking	Number Distance	Symbol Rotation	Reasoning	Literacy	Numeracy
RT1 General Reasoning	0.40	0.31	0.44	0.44	0.48	0.61	0.59
RT2 Literacy	0.39	0.31	0.35	0.30	0.41	0.75	0.54
RT3 Numeracy	0.46	0.31	0.35	0.38	0.49	0.55	0.73
RT4 Mechanical	0.19	0.15	0.28	0.38	0.27	0.41	0.37

All correlations  $p < 0.01$

Table 3. Table showing NPS and RT subtest intercorrelations

### BARB vs NPS ABC

In this study 353 army applicants at RSC were administered the NPS ABC tests having previously sat BARB. The delay between the two test administrations was approximately one month. A correlation between BARB GTI and ABC Total of 0.69 was obtained (0.77 when corrected for unreliability). The inter-correlations between the subtests are shown in Table 4. These intercorrelations range from low to high. High correlations can be seen between the two number distance tests and the two symbol rotation tests. The correlations between the respective transitive inference and reasoning tests and the two letter checking tests are moderate.

	BARB					
ABC	Alphabet F/B	Letter Checking	Number Distance	Symbol Rotation	Synonyms /Antonyms	Transitive Inference
Letter Distance	0.36	0.28	0.41	0.27	0.39	0.42
Letter Checking	0.25	0.42	0.26	0.25	0.18	0.31
Number Distance	0.23	0.23	0.71	0.23	0.33	0.41
Symbol Rotation	0.23	0.21	0.32	0.71	0.31	0.30
Reasoning	0.21	0.27	0.43	0.19	0.41	0.47

All correlations  $p < 0.01$ *Table 4 Table showing NPS ABC and BARB subtest intercorrelations*

A factor analysis of the subtests yielded a two-factor solution with the two number distance tests, the transitive inference and reasoning tests, the letter distance and letter checking tests loading on the first factor. The second factor was made up of the two symbol rotation tests and the two letter checking tests.

## SUMMARY OF FINDINGS

A summary of the composite intercorrelations from the different studies is shown in **Table 5**.

	BARB GTI	ABC Total	NPS Total	GTTB GAI	RT Total
BARB GTI		0.69 (0.77)	?	0.66 (0.77)	?
ABC Total				0.60 (0.71)	0.59 (0.70)
NPS Total				0.66 (0.77)	0.67 (0.78)
GTTB GAI					?
RT Total					

All correlations  $p < 0.01$ ; ( ) denotes correction for unreliability*Table 5. Summary table showing inter-correlations of the different composite scores*

## DISCUSSION

All the current and proposed UK service selection tests were designed to measure the construct of general intelligence. The core subtests of the BARB and NPS batteries are based upon Carroll's three-stratum model of the intellect, whilst the RT and GTTB tests are based around the work of Spearman. The findings of the studies reported in this paper show considerable overlaps between all the batteries and support the view that all the batteries are measuring general intelligence, although perhaps in slightly different ways. There would appear to scope for the rationalisation of current service selection tests and the introduction of a single test for tri-service use. Practical constraints placed limitations on the collection of data, which were collected operationally as part of the selection process. The delay between initial testing and retesting, practice effects, and motivational effects may all have served to limit the correlations observed.

An initial surprise in the findings was the relatively low correlation between the BARB and NPS batteries. Given the fact that a considerable number of the subtests share a common theoretical underpinning, higher correlations were expected. Bartram (1994)

and Mead and Drasgow (1993) give useful reviews of the equivalence of pencil and paper and computerised versions of tests. Mead and Drasgow's meta-analysis found that power-based tests transfer quite well across media, whereas this was often not the case for speeded tests. Modality of presentation would appear to have had a significant impact on testees' performance across the BARB and NPS tests.

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