Commonalities in an uncommon profession: Bomb disposal

Edwin Bundy
Technical Support Working Group (TSWG)
Explosives Detection Subgroup

Roderick Sims
Instructional Design for Online Learning
Capella University

The bomb disposal community seeks to attract, train, and retain individuals who are physically, mentally, and emotionally capable of performing diverse and complex tasks. However, while bomb disposal technicians and organisations tend to believe that bomb disposal requires a certain "type" of individual, little research has been conducted to identify the cognitive characteristics that make a "good" bomb disposal technician. The purpose of this study therefore was to investigate the extent to which individual learner preferences, as measured by learning styles and multiple intelligences, impacts on the effectiveness of bomb disposal training. The investigation used a non-experimental, descriptive methodology, and focused on a geographically dispersed group of 100 current and former bomb disposal technicians. The Canfield Learning Styles Inventory (LSI) and Multiple Intelligences Developmental Assessment Scales (MIDAS) instruments were used to assess learning style preferences and intelligence strengths. Overall, ten demographic variables, eight intelligence strengths, and 17 learning style preferences were examined, covering 250 different dimensions, 16 of which (6.4 %) showed a statistically significant difference between intelligence strengths and learning style preferences. The data supports the contention that learning style preferences and intelligence strengths can be used as predictors for academic and vocational success. As such, the results have specific implications for bomb technician education and training in terms of technician selection and the potential to learn and retain the knowledge and skills being taught.

Keywords: multiple intelligences, learning styles, bomb disposal

Introduction

Conflicts between governments and peoples have continued to escalate, and the use of explosive items such as military ordnance, landmines, and improvised explosive devices (IEDs) has increased dramatically over the last few decades (Electronic Mine Action Network, n.d.). As of August 6th, 2005, 6,641 service members in Iraq had been wounded by IEDs (Burgess, 2005), while iCasualties (n.d.) reports 1588 IED related fatalities in Iraq from July 2003 to August 2007. In a presentation for the 2005 annual training conference of the International Association of Bomb Technicians and Investigators (IABTI), Dr. Bruce Tefft of the Community Research Center stated that over 80 military bomb disposal technicians died in the line of duty in Iraq from January 2003 to June 2005, and many others have sustained injury. To put this in perspective, only 17 bomb technicians died in Northern Ireland between 1969 and 1981, during which time 31,273 IEDs were dealt with (Rachman, 1983).

Bomb disposal is inherently dangerous and the bomb disposal community seeks to attract, train, and retain individuals who are physically, mentally, and emotionally capable of performing the diverse and complex tasks required of bomb disposal technicians (Bates, 2002; Cooper, 1982; Cox, Hallam, O'Connor, & Rachman, 1983; Hogan & Hogan, 1989; Humphrey, 2000; McCormick & Clutch, 1991; O'Connor, Hallam, & Rachman ,1985; Young, 2000). The bomb disposal career field is, and has always been, chronically understaffed, partially because of attrition during initial training, which fluctuates between 30-60 percent in most bomb disposal schools, and partially due to voluntary separation from bomb disposal duty due to stress (Bates, 2002). Therefore, there is an ongoing need to better understand what makes a good bomb disposal technician to ensure more reliable and consistent performance in the field (Air Land Sea Application Centre, 2005). Research suggests that bomb disposal technicians may have common characteristics. For example, O'Connor et.al. (1985), suggest, "...the identification of a low cardiac level associated with stress among decorated bomb-disposal operators has been confirmed. Taken in conjunction with earlier findings of a distinctive psychometric profile in decorated operators [R.

Hallam & S. Rachman, 1980, Person. & Indiv. Diffs.], the results suggest that, as with fear, there may be consistent physiological indices of courage."

Just as some people are not physically well suited for bomb disposal duty, some are not cognitively well suited for bomb disposal. Mismatches between the learning style preference or intelligence strengths of an individual interested in entering the bomb disposal field, and those of individuals who have been successful members of the bomb disposal community may provide a methodology by which to determine whether or not an individual is cognitively well suited for bomb disposal. Understanding the learning style preferences and intelligence strengths of current and former bomb disposal technicians, and learning style preferences and intelligence strengths of potential bomb disposal technicians has major implications for bomb disposal training, but research is required to uncover the extent of those implications. If bomb disposal technicians have a unique set of personality traits, understanding their learning style preferences (individual differences in the way one learns, Kolb, 1984) or intelligence strengths (a demonstration of a person's ability to process information in order to solve problems or create things; Gardner, 1999a) is essential to inform future training and development. The purpose of this study was therefore to investigate the extent to which individual learning preferences, as measured by learning styles and multiple intelligences, impacts on the effectiveness of training programs for bomb-disposal technicians.

Methodology

The population studied consisted of active and former military explosive ordnance disposal technicians and public safety bomb technicians who were members of The International Association of Bomb Technicians and Investigators (IABTI). This study used a snowball sample that began by e-mailing current members of IABTI a request for participation in the study, and asking those solicited to pass on the request to other current and former technicians. Demographic data was collected to analyse the sample and for comparative analysis with learning styles and intelligences.

Participants' learning style preferences were measured using The Canfield Learning Styles Inventory (LSI), a 30-item self-report questionnaire that allows an individual to describe the features of their educational experience that they most prefer, and has been demonstrated to have a high degree of reliability (Canfield, 2000; Stitt-Gohdes, 2001). The variables measured by the LSI (Tecweb, 2005) were:

1. Peer: Working in student teams; good relations with other students; having student friends;.
2. Organisation: Course work logically and clearly organised; meaningful assignments and sequence of activities.
3. Goal-Setting: Setting one's own objectives; using feedback to modify goals and procedures; making one's own decisions about objectives.
4. Competition: Desiring comparison with others; needing to know how one is doing in relation to others.
5. Instructor: Knowing the instructor personally; having mutual understanding; liking one another.
6. Detail: Specific information on assignments, requirements, rules, and so forth.
7. Independence: Working alone and independently; determining one's own study plan; doing things for oneself.
8. Authority: Desiring classroom discipline and maintenance of order; having informed and knowledgeable instructors.
9. Numeric: Working with numbers and logic; computing; solving mathematical problems; and so forth.
10. Qualitative: Working with words or language; writing, editing, talking.
11. Inanimate: Working with things; building, repairing, designing, operating.
12. People: Working with people; interviewing, counseling, selling, helping.
13. Listening: Hearing information; lectures, tapes, speeches.
14. Reading: Examining the written word; reading texts, pamphlets.
15. Iconic: Viewing illustrations, movies, slides, pictures, graphs.
16. Direct-Experience: Handling or performing; shop, laboratory, field trips, practice exercises.

Responses to the Multiple Intelligences Developmental Assessment Scales (MIDAS) were computer-scored on a 5-point scale. A three-page qualitative and quantitative profile is generated, with the first two pages containing both verbal and graphic information representing the main and specific scales describing where the person rated him or herself. The eight intelligences measured are:

1. Linguistic: the potential to use language, as used in reading, writing, telling stories, memorising dates, and thinking in words.

2. Logical-Mathematical: the potential for understanding cause and effect and for manipulating numbers, quantities, and operations, as used in math, reasoning, logic, problem solving, and recognising patterns.
3. Spatial: the potential for representing the spatial world internally in one's mind as used in reading maps and charts, drawing, solving mazes and puzzles, imagining and visualising.
4. Kinesthetic: the potential for using one's whole body or parts of the body, as used in athletics, dancing, acting, crafting, and using tools.
5. Musical: the potential for thinking in music; for hearing, recognising, and remembering patterns, as used in singing, identifying sounds, and in remembering melodies and rhythms.
6. Interpersonal: the potential for working with others, as used in understanding people, leading and organising others, communicating, resolving conflicts, and selling.
7. Intrapersonal: the potential for understanding ourselves, as used in understanding self, recognising one's own strengths and weaknesses, and setting personal goals.
8. Naturalistic: the potential for discriminating among plants, animals, rocks, and the world around us, as used in understanding nature, making distinctions, identifying flora and fauna (Gardner, 1999a).

Analysis of the demographic data and scoring of completed LSI was performed by the researcher, but MIDAS instruments were computer-scored by its distributor. Frequency distributions were then used to construct profiles of the demographic data and the bomb technicians' learning style profiles and intelligences. Microsoft Excel's descriptive statistics analysis tool was used to generate the reports of univariate statistics for individual variables within each demographic, which provided information about the central tendency and variability of the data collected. In addition, a one-way between-group analysis of variance (ANOVA) determined if significant difference existed between military explosive ordnance disposal technicians and public safety bomb technicians in their learning style preferences, as well as whether or not there were statistically significant difference between demographic variables for learning style preferences or intelligence strengths.

Results

Demographic variables, learning style preferences and intelligence strengths were examined with respect to the bomb technician population being studied, resulting in 250 different dimensions being available for analysis. Sixteen of the 250 dimensions (6%) showed a statistically significant difference, and are the focus of the following analysis in this paper.

There were statistically significant differences in learning style preferences for bomb technicians sampled with respect to the *Peer* preference by Age, Nationality, and Bomb-Disposal-School-Graduated; *Instructor* and *Detail* preferences by experience level. In addition, statistically significant differences existed for the *Logical/Mathematical* and *Kinesthetic* intelligences with respect to age; *Spatial*, *Interpersonal*, and *Intrapersonal* intelligences with respect to ethnicity; and *Interpersonal* intelligence with respect to the bomb disposal school from which participants graduated. With respect to Sector (military and public safety), the *Instructor* and *Detail* learning style preferences showed statistically significant differences, as did the *Interpersonal* intelligence. By nationality (US or non-US), a statistically significant difference existed for the *Peer* preference, and *Spatial* and *Interpersonal* intelligences.

Demographics

Overall, the median age (in years) of participants was 42, while the youngest participant was 24 and the oldest 70. Only two percent of participants were female, while 90 percent were ethnically Caucasian/White. The level of education among participants varied greatly, with 83 percent having either some college or having completed a degree, or advanced degree. Overall, 68 percent of participants reported having a military affiliation, while 32 percent reported being affiliated with public safety; seven percent of individuals reported having been involved in both military and public safety bomb disposal; however, for the purpose of this study, participants will be counted as military if their original bomb disposal training was conducted through the military, and public safety if it was conducted through a non-military organisation. By nationality, seventy-four percent of participants reported being from the Unites States, graduating from either the Federal Bureau of Investigation's Hazardous Devices School (HDS) or the US military's Naval School, Explosive Ordnance Disposal School (NAVSCOLEOD). The median number of years experience as bomb disposal technicians was 13, with two participants having as little as one year of experience and two having over 40, with a total of 1385 years of experience being reported by respondents.

In terms of general demographics, 50 percent of participants reported being former bomb disposal technicians, while 50 percent stated they are in positions with render safe responsibilities; 47 percent of participants reported being actively involved in bomb disposal related positions. Six percent of participants were in a combat zone while participating in the study. With regard to training, 45 percent of participants reported being former bomb disposal school instructors, 42 percent reported being in positions where they are actively training bomb disposal technicians, and 62 percent reported being active trainers in general.

Learning Styles Inventory

For group data analysis of LSI results, participants reporting a preference in the 1-25th percentile are categorised as having a *Low* preference; those in the 26-49th percentile, a *Moderate-to-Low* preference; 50-74 percentile, a *Moderate-to-High* preference; and 75-99 percentile, a *High* preference. According to Canfield (2000), this is beneficial for analysis of the group in that the expectation for a normal distribution to be 25 percent of participants in each category. If distributions are strongly disproportion in the *High* or *Low* category, this is an indication of a stronger than usual preference or aversion for that particular learning characteristic for the group as a whole. That being said, group summary data suggests that overall, the majority of bomb disposal technicians who participated in this study (63, 60, 44, and 36 percent, respectively) had a *High* preference, above 75 percent, for the *Detail, Authority*, *Organisation*, and *Competition* Conditions-for-Learning; the *Inanimate* Area-of-Interest (53 percent); and the *Direct-Experience* Mode-of-Learning (46 percent). Conversely, participants had a *Low* preference, below 25 percent, for the *Instructor*, *Independence*, *Goal-Setting*, and *Peer* Conditions-for-Learning (59, 46, 42, and 36 percent, respectively); the *People* Area-of-Interest (37 percent); and the *Reading*, and *Listening* Mode-of-Learning (50, and 28 percent respectively).

The last two areas from the LSI to consider concern what Canfield (2000) refers to as *Expectation-for-Course-Grade*, and *Learner Typology*. With respect to *Expectation-for-Course-Grade*, the scale that indicates the level of performance an individual expects of him- or herself, participant response was the most disproportionate. Overall, 72 percent of participants rated themselves in the highest quartile, 20 percent in the *Moderate-to-High* quartile, and 4 percent each in the *Moderate-to-Low* and *Low* quartiles. Each of the scales discussed above (*Peer, Organisation, Goal-Setting, Competition, Instructor, Detail, Independence, Authority, Numeric, Qualitative, Inanimate, People, Listening, Reading, Iconic, Direct-Experience, and Expectation-for-Course-Grade*) were developed as discreet elements based on their lineage from educational and psychological research (Canfield, 2000). However, the *Learner Typology* scale looks at correlations among the various scales and identifies those that form complimentary preferences. As Canfield (2000) states, "Based on the correlation among scales in a substantial set of students…the typology shows how combinations of 10 LSI scales may be used to identify 9 distinct types of students" (p. 26).

Table 1: Learner typology: Percentage by type

Learner Typology: Percentage by Type

Typology	Norm	Participants
Social	11	9
Social/Applied	11.5	16
Social/Conceptual	11.5	9
Conceptual	10.5	9
Neutral	10	11
Applied	10.5	11
Independent/Applied	11.5	16
Independent/Conceptual	11.5	10
Independent	11	9

Note. Expected proportions for typology norms are based on information provided y Canfield (2000, Table 3, p. 26).

Table 1 identifies learner typologies for participants in this study as compared to the norms identified by Canfield (2000). As can be see in the table, two typologies appear to be dominate: *Social/Applied* and *Independent Applied*. According to Canfield (2000), individuals who fall within the *Social/Applied* typology prefer opportunities to interact with other students and instructors in learning situations that approximate real-world environments. These individuals are less comfortable with self-directed learning or solitary activities that involve a great deal of reading or other language component. Those individuals falling within the *Independent/Applied* typology are similar to the *Social/Applied* student in that they prefer learning environments that simulate real-world experiences, and have a general aversion for

learning situations that depend heavily on conceptually organised and language-oriented material. However, *Independent/Applied* students prefer to work alone, following a self-selected path toward some individual goal (Canfield, 2000).

Multiple intelligences

Results for the Multiple Intelligence Developmental Assessment Scales (MIDAS) instrument were left in percentile format. This format was chosen in part because of the nature of the data provided by the computer-scoring process, and in part for ease of comparison with norms from previous research provided by Shearer (1996). The results from the population surveyed were considered unusual by Dr. Branton Shearer, the developer of the instrument. Overall, the bomb technicians sampled consistently rated themselves low on the various scales as compared to individuals from other segments of the population. In addition, Dr. Shearer indicated that the results were unusually consistent within the population sampled (Shearer, personal communication, April 19, 2006).

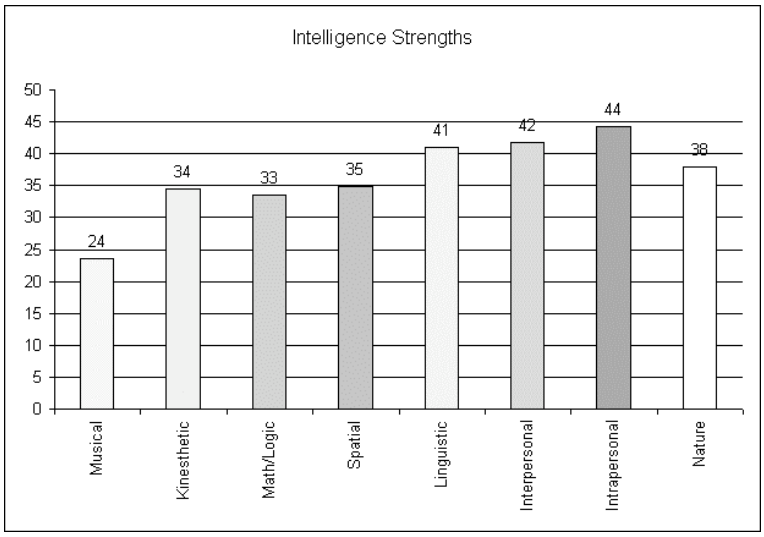

Figure 1: Mean intelligence strength scores

Overall, mean scores suggest that *Intrapersonal Intelligence* is the strongest intelligence for the population sampled (M=44, N=100), followed closely by *Interpersonal* and *Linguistic* intelligences (M=42 and 41, respectively). According to Shearer (1996), the intrapersonal intelligence scale indicates an individual's relative level of self-awareness and his or her ability to analyse their own strengths and weaknesses, while the interpersonal intelligence score suggests an individual's relative ability to understand others through empathy and an accurate assessment of their motives and intentions. He also suggests that the linguistic intelligence score is a measure of an individual's ability to understand and express complex meaning through the use of words and language. As indicated in Figure 1, the *Naturalist Intelligence* had the next highest mean score (M=38), followed by *Spatial*, *Kinesthetic*, and *Logical/Mathematical* intelligences (M=35, 34, and 33 respectively. The musical intelligence had the lowest mean score (M=24) among the population sampled, with the musical intelligence score indicating an ability to think in terms of sounds, rhythms, and melodies; perform using either voice or instrument; or have an emotional connection with music (Shearer, 1996).

Significant findings

The data collected during this study produced statistically significant findings that supported the contention that bomb technicians have similar learning style preferences and intelligence strengths; however, the data also suggested that variations existed both within, and between the various demographics. But, as stated by Phillips (2000), "…even though a difference is shown to be statistically significant, it may or may not have any *practical* significance" (p. 120). As both similarities and differences in learning style preferences and intelligence strengths affect the learner, and by association, his or her learning environment, a closer examination of the data was required in order to sufficiently answer the primary research question for this study, which asked, "In what ways do learning style preferences and multiple intelligence characteristics impact on the training of bomb disposal technicians?" Data collected suggests that certain commonalities exist in learning style preferences and multiple intelligence strengths among the bomb technicians who participated in this study, but the extent

of commonality varies by demographic factors, and the learning style preferences or multiple intelligences being discussed. For organisational purposes, findings regarding learning style preferences will be discussed first, followed by information on intelligence strengths.

Discussion

The process of bomb disposal training and certification varies by country, as does the content and length of training. In some instances the courses are as short as six weeks (e.g. FBI Hazardous Devices School and the U.S. Department of State's Explosive Incident Countermeasures Course), and at least one, the Hong Kong Explosive Ordnance Disposal Bureau's program, lasts four years, according to Senior Bomb Disposal Officer, Dominic 'Bones' Brittain (personal communication, July 2005). However, curricula for bomb disposal training tends to focus on memorisation and implementation of lock-step procedures. In reviewing the curricula of the U.S. Department of State's Explosive Incident Countermeasures Course, and the U.S. military's Explosive Ordnance Disposal School, learning objectives rarely reach higher order levels of thinking such as *analysis*, *synthesis*, and *evaluation*, instead focusing on *knowledge*, *comprehension*, and *application* (Fowler, 2004), with many of the learning objectives containing verbiage such as *identify*, *describe*, *comprehend*, *recognise*, and *utilise*, and *perform*. This is no doubt due, in part, to the fact that most bomb disposal training programs fall under military training programs, or law enforcement agencies, both of which tend to use more traditional approaches to training.

As might be suspected, the public safety bomb technician performs fundamentally the same function as the military explosive ordnance disposal technician; there are differences however. For example, the responsibility for military ordnance is the direct responsibility of the military bomb disposal technician in most countries, with one exception being Israel. However, most public safety bomb technician will attempt to conduct operations involving military ordnance when necessary, but public safety bomb technicians are more well versed in evidence collection and preservation, while military bomb disposal technicians receive limited, if any training in this area. This research focused on commonalities of learning style preferences and intelligence strengths among a geographically dispersed group of current and former bomb disposal technicians. While the data gathered during this research supports the contention of many educational theorists that learning style preferences and intelligence strengths can be used as predictors for academic and vocational success (e.g., Gardner, 1999a; Kolb, Boyatzis, & Mainemelis, 1999), it has specific implications for the bomb technician education and training community in terms of how future bomb disposal technicians are selected and trained, and the extent to which a potential exists for those being trained to learn and retain the knowledge and skills being taught.

Learning style preferences

Based on the population sampled, there were several learning style preferences, as measured by the Canfield Learning Styles Inventory (LSI), for which the bomb technicians had strong preference, and several for which they had strong aversion. In the area of *Conditions-for-Learning*, the preferred situation or context of instruction, technicians had the strongest preferences for *Detail*, *Authority*, *Organisation*, and *Competition* conditions. In *Area-of-Interest*, the preferred subject matter or objects of study was in the *Inanimate* area, and for *Mode-of-Learning*, the manner by which an individual obtains new information, the strongest preference was for *Direct-Experience*. However, the area showing the greatest commonality among the population sampled was *Expectation for Success*, which assesses the individuals own anticipated level of performance for a given situation or experience. In this area, almost all of the participants rated their expectation for success as *High*.

With respect to those facets of learning style preference for which the population sampled had strong aversion, these consisted of *Instructor*, *Independence*, *Goal-Setting*, and *Peer* for Conditions-for-Learning; *People* for Area-of-Interest; and *Reading* and *Listening* for Mode-of-Learning. Based on the areas of strongest preference, the results regarding strongest aversions were to be expected. As noted by Canfield (2000), "A student who exhibits an extremely high or low preference on one scale within a set of four will automatically have scores that tend to fall toward the opposite extreme on the other scales in that set" (p. 19). For *Learner Typology*, the scale that looks at correlations among the *Organisation*, *Qualitative*, *Reading*, *Direct-Experience*, *Inanimate*, *Iconic*, *Peer*, *Instructor*, *Goal-Setting*, and *Independence* scales and identifies those that form complimentary preferences, the majority of participants were identified as either *Social/Applied*, and *Independent Applied*. Individuals with a Social/Applied preference favor interaction with other students and instructors while engaging in activities that closely approximate real-world experiences, while those with an Independent/Applied preference prefer to work alone during the same types of activities.

Intelligence strengths

A high degree of similarity existed among the bomb technician population sampled, regardless of variable examined (i.e., Sector, Country-of-Origin, Age, Experience-Level, and so on). The mean scores for individuals within a group using MIDAS are normally fairly evenly distributed among the various intelligences, with some being high and others being low, but most centering around the 50th percentile (Shearer, 1996). Overall mean scores for the group average out around the 50th percentile, forming a relatively standard bell curve. It is interesting to note however, that compared to the mean scores of other populations, the bomb technicians in this sample rated themselves significantly lower, on average, than other populations. Of the eight intelligence strengths measured by MIDAS (*Linguistic*, *Logical/Mathematical*, *Spatial*, *Kinesthetic*, *Musical*, *Interpersonal*, *Intrapersonal*, and *Naturalist*), the population sampled scored highest in *Intrapersonal* intelligence, followed closely by the *Interpersonal* and *Linguistic* intelligences. A high score on the Intrapersonal scale indicates a high degree of self-efficacy, which is also reflected in the mean score of participants on the Expectation-for-Success scale for the LSI. Given that this intelligence ranked highest overall among participants, and that *Expectation-for-Success* was rated highest among the learning style preferences, this characteristic may well serve as an indicator of potential success for future bomb disposal technicians.

Among the remainder of the intelligences, the mean scores were slightly less, with only *Musical* intelligence falling significantly below the mean scores of the other intelligence strengths. The reason for the disparity between the *Musical* intelligence and other intelligences is unknown, but bears further investigation.

Results of MIDAS also include two subscales; one for *Intellectual-Style*, the other for *Leadership*. The Intellectual-Style subscale compares *Leadership*, *Innovation*, and *General Logic*, and according to Shearer (1996), suggests whether an individual tends to be more practical, innovative, or social in their problem solving skills. For the population sampled, *Leadership* had the highest overall mean score, with *General Logic* following closely behind. *Innovation* had the lowest mean score, falling significantly below the other two scales. In terms of characteristics that contribute to success as a bomb technician, this studies data suggests that one possible characteristic may be a comfortability with being responsible for, or in control of situations where analysis rather than abstract thinking is required.

Anecdotally bomb technicians think of themselves as extremely innovative, having to think quickly on their feet, and coming up with novel solutions to loosely defined and often ambiguous problems. However, if the mean score on the *Innovation* scale is viewed in relation to a *High* preference for *Detail* and *Organisation* on the LSI, and a *Low* preference for Independence, a picture begins to emerge of an individual that relies more on well-established procedures and protocols than innovation. In addition, most, if not all bomb disposal schools emphasise to students the necessity for following established protocols and procedures, which is understandable given the hazardous nature of the work for which the trainee's skills are being developed. Table 2 identifies bomb disposal Innovation scores as compared to other occupations.

Table 2: Innovation scores by occupation

Occupation	Score
Pilot	49
Skilled Tradesperson	48
Firefighter	46
Police	44
Bomb Technician	32

Note. Data for other than bomb technicians are based on small sample sets provided by Shearer (1996).

The Leadership subscale is further broken down into *Communication Skills*, *Managerial Skills*, and *Social Adeptness*. The mean scores for each of these scales were generally comparable among the population sampled, with the exception that military participants tended to score lower on the *Social Adeptness* scale than their public safety counterparts. It can be argued that this is an understandable phenomenon, based on the premise that public safety bomb technicians generally interact more with the public at large than do military technicians, and would therefore gain more skill in this area, but empirical data would need to be collected to support this contention. It bears mentioning however that the mean scores for *Social Adeptness* in the public safety bomb technicians sampled were still significantly lower than the mean scores of their non-bomb technician counterparts in both law enforcement and firefighting (Shearer,

1996). Given the overall low self-assessment scores on the MIDAS, a question is raised as to the relationship between this phenomena and *Intrapersonal* and *Interpersonal* intelligences, as these two intelligences have the highest mean scores of all the intelligences for the bomb technicians sampled.

Even more puzzling, given that the bomb technician training community places such a great deal of emphasis in the hands-on nature of the career field, is that when placed in rank-order, *Spatial* and *Kinesthetic* intelligences ranked in the bottom half of the intelligences for the population sampled. As the *Spatial* and *Kinesthetic* intelligences are most closely aligned with what may be considered "hands-on" skills, it was expected that these intelligences would be highest when rank-ordered. However, not only were *Intrapersonal* and *Interpersonal* intelligences ranked ahead of *Spatial* and *Kinesthetic* intelligences, but *Linguistic* and *Naturalistic* intelligences were ranked ahead as well. Therefore, in terms of this investigation into the characteristics that contribute to success as a bomb technician, this suggests that while hands-on skills are a fundamental requirement for performance of bomb disposal duties, the characteristics that contribute to a technicians overall success and effectiveness may be linked to more intangible qualities. It also stands to reason that these same intangible qualities may contribute to an individual's self-selection for the bomb disposal profession.

So, do introspection and reflection, traits potentially garnered from intrapersonal intelligence strength, contribute to a successful bomb technician's perceived control over his or her environment, actions, and destiny? Is there a potential connection between intrapersonal intelligence and a bomb technician's ability to cope with the stresses of the job? Furthermore, does a bomb technician's level of interpersonal intelligence allow him to see these qualities in others, contributing to a bomb technician assessment and selection process that relies almost exclusively on a personal interview? The extent of this relationship requires further investigation in order to ascertain the extent to which intrapersonal and interpersonal intelligences permit bomb technicians to cope with the stresses inherent in their career field, and to determine how the quantification of these intelligences can be used to inform the assessment and selection process.

Bomb technician assessment and selection

Extensive research has been conducted into learning styles, but more investigation is required. One such area is the relationship between learning style preferences and vocational choice. For example, Kolb (1984); and Kolb, Boyatzis, and Mainemelis (1999) found that people tend to select professions in which colleagues have similar learning style preferences. Multiple Intelligence theory often refers to career paths when providing examples of skills that demonstrate particular intelligence strengths (e.g., Gardner, 1983, 1993, 1999). Several researchers investigating the relationship between adults and multiple intelligence strengths indicate that various vocational choices may be the result of inclinations based on specific intelligence strengths or weaknesses (e.g., Malm, 2001; Shearer, 2005).

Some educational theorists (e.g., Gardner, 1983; Kolb, 1984; Kiersey, 2000) suggest that influences other than *general cognitive ability* play a major role in learning success, and would therefore be pertinent to bomb technician assessment and selection. Somewhat tangentially, Tesluk and Jacobs (1998) suggest that individual differences are a critical predictor of the work experiences people pursue and impact the types of training they receive. Noe and Colquitt (2001) support this contention, and indicate that training success is determined by not only the effectiveness of a specific training methodology, but by interpersonal and social influences, as well as factors such as motivation, and job and career attitudes. In addition to this study, prior research suggests that ranges of mental, physical, and emotional characteristic appear to exist that are common to successful bomb technicians (Bates, 2002; Campbell, 2001; Cooper, 1982; Cox at al, 1983; Hogan & Hogan, 1989; Humphrey, 2000; McCormick & Clutch, 1991; O'Connor, Hallam, & Rachman ,1985; Young, 2000). These are measurable characteristics, both quantitatively and qualitatively, and as such, should be the basis for a formalised bomb technician assessment and selection process. While in the past it could be said that the chances of a bomb technician being required to render safe more than a few IEDs during his or her career was practically nonexistent, the proliferation of IEDs as a terrorist weapon of choice makes encountering these devices with some degree of regularity a certainty. Even if the number of explosives related incidents were not on the increase, one could still argue for a well-reasoned and systematic approach for bomb technician assessment and selection based on the very nature of the job. Yet the process of bomb technician assessment and selection appears to be a haphazard process based mainly on what is often referred to as *expert opinion*, which is purported to be developed by direct exposure to subject matter over an extended period. But even if a reader regards expert opinion as prima facie evidence for an assessor's ability to judge a potential bomb technician's individuals skills, abilities, inclinations, motivations, and emotional stability, the fact remains that this type of selection process is still *just opinion*.

One job analysis approach that may be of benefit in helping to develop an assessment and selection process for bomb technicians is cognitive job analysis, more commonly referred to as *cognitive task analysis* (CTA) (Sackett & Laczo, 2003). By looking at the differences between expert and novice performance, this approach attempts to identify and model the cognitive processes necessary for task performance, or the thought processes that guide behavior (Chipman, Schraagen, & Shalin, 2000). This is in stark contrast to *behavioral task analysis*, which looks at job performance in terms of actual tasks performed. While the results of this research indicate that, at a minimum, a potential bomb technician needs to be assessed regarding expectation for success; preference for, and ability to perform applied skills; and strength in his or her intra- and interpersonal intelligences, this picture is far from complete. As such, a more comprehensive profile be developed that looks at psychological and neuropsychological dimensions, to include such factors as self-concept/self-esteem; social, visual spatial, visual motor, and language skills; attention; memory; ability; achievement; behavioral-emotional assessment; and executive function.

Conclusion

By way of conclusion, and to reiterate points made earlier, this research indicates that the bomb technicians who participated in this study had similar intelligence strengths and learning style preferences. As such, it is reasonable to believe that these individuals may have been drawn, in part, to the bomb disposal career field as a result of those intelligence strengths and preferences. For those who are concerned with selecting the best, or most appropriate candidates for a particular occupation or area of specialisation, this suggests that measuring intelligence strengths and learning style preferences may be *one mean* by which to achieve his or her goal. In addition, the data showed that learning style preferences among study participants varied in relation to a number of demographic factors. As such, those training programs where the student population is non-homogeneous need to create learning environments that address as many learning style preferences as possible in order to be of maximum benefit to all students.

In addition to providing a mechanism by which to improve selection criteria for those entering the bomb disposal field and increasing the potential for academic success and retention of those trained, the results of this study may also be used to provide bomb disposal trainers and curriculum developers with data to support changes in bomb disposal training. This will allow these individuals to better meet the learning styles and intelligences of those entering the bomb disposal field. By knowing and understanding the learning styles/multiple intelligences (LS/MI) of the typical bomb disposal technician, trainers will also be able to identify key areas of training that may contribute to problems for bomb disposal technicians. In addition, if a bomb disposal technician knows his or her own LS/MI, it will contribute to self-efficacy thereby affording the bomb disposal community better training and better trained personnel.

Finally, this research also indicates that while related, learning style preferences and intelligence strengths are different sides to the same coin; each adding a unique dimension to individuality. This is not to say that one should be given credence over the other, rather, that each should be considered independently. Gardner himself has identified eight intelligences (*Musical*, *Kinesthetic*, *Linguistic*, *Logical-Mathematical*, *Spatial*, *Interpersonal*, *Intrapersonal*, and *Naturalist*), and is considering a ninth, an *Existential* intelligence, but he leaves room for the possibility that other intelligences may exist (Gardner, 1999). This combined with a lack of research that identifies *the* definitive learner characteristics and conditions that produce the perfect learning environment, suggests that a battery of tests should be used that identify learning style preferences *and* intelligence strengths. In the end this research supports the contention that students are individuals, and regardless of the tool by which they are measured, will always be inextricably linked by commonalities and separated by differences. It is whether or not learners and educators choose to acknowledge those similarities and differences that will inform the learning.

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Edwin Bundy *PhD*
bundye@tswg.gov
Roderick Sims *PhD*, Capella University
Rod.Sims@faclty.capella.edu

Please cite as: Bundy, E. & Sims, R. (2007). Commonalities in an uncommon profession: Bomb disposal. In *ICT: Providing choices for learners and learning. proceedings ascilite Singapore 2007*.
https://doi.org/10.65106/apubs.2007.2828