Improving Military Decisions with a Fast and Frugal Tree approach

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Abstract

Senior officials and expert decision-makers in the British Army report junior officers' increased tendency to inaccurately classify civilians' towns and military sites at night. Hence, this essay aims to resolve this by developing a cognitive tool to aid their decision-making while providing a reasonable argument for such a tool. A fast and frugal heuristic method is suggested due to its ability to describe the decision-making processes of experienced decision-makers in domains with structural and analytical approaches to the decision-making process.

This essay suggests a Fast and Frugal Tree (FFT), a non-compensatory type of FFH. FFTs are fast in that they have three (3) basic building blocks, are quick in predicting binary outcomes, and are frugal in that they have been shown to use minimal information and only critical cues (factors) when searching, stopping, and deciding. Unlike Naturalistic Decision Models (NDMs), they have been indicated to be beneficial to inexperienced decision-makers as selected cues depend not on experience but on the environment. As a simple categorization model, FFTs are advantageous in situations characterized by uncertainty, time pressure, and limited information. Evidence reviewing the application of FFH across relevant domains points towards its prospective adoption in military decision-making.

Although the suggested cognitive tool successfully mapped out an FFT that could aid junior infantry officers, there are particular concerns about its inability to consider cue interaction and limitations in evaluating its effectiveness against other decision strategy processes.

Introducing Fast & Frugal Heuristics in Military Decision Making

Decision-making in the military is usually a process taught as a sequence of procedures and analytical steps where emphasis is laid on leveraging logical deduction in complex and ill-structured situations (Shortland et al., 2019). However, given time-pressure constraints, this mix of subjective and objective processes can be challenging to follow in practice (Mathew, 2014).

Most decision-making situations require the expertise of senior officers with accumulated years of experience to make the best and optimal decision, one of which is by recognizing and recalling typical contextual lines of actions or plans (Klein, 1993).

Senior officers have raised issues with junior officers misclassifying civilian towns and military sites. Efforts have been made to model the decision-making process of these experienced decision-making senior officers. The Naturalistic Decision-Making (NDM) programmes (Orasnu & Connolly, 1993) are one of such efforts. However, NDMs are recognition-primed decision-making models that draw cues from experience (Kahneman & Klein, 2009) rather than from the environment. Following up on the benefits of simple heuristics (Gigerenzer et al., 1991), Gigerenzer & Gaissmaiser (2011) popularized that some heuristics are fast and frugal in that they use limited information (minimal cues) in uncertain and time-pressured situations to make a satisfactory decision. Martigon (2008) further democratized the prospects of Fast and frugal Trees (FFTs), a type of Fast and Frugal Heuristics (FFH), stressing that they are best used under conditions of limited time, information, and computation constraints.

Evidence Evaluation: Why a FFH Approach (Fast & Frugal Trees [FFTs]) should be Considered

The advantages of heuristics outweigh the drawbacks Kahneman et al. (1982) highlighted in their work referencing the theory of bounded rationality (Simon, 1955). So many FFHs have been applied consciously and unconsciously across several domains, with most findings pointing toward its adoption.

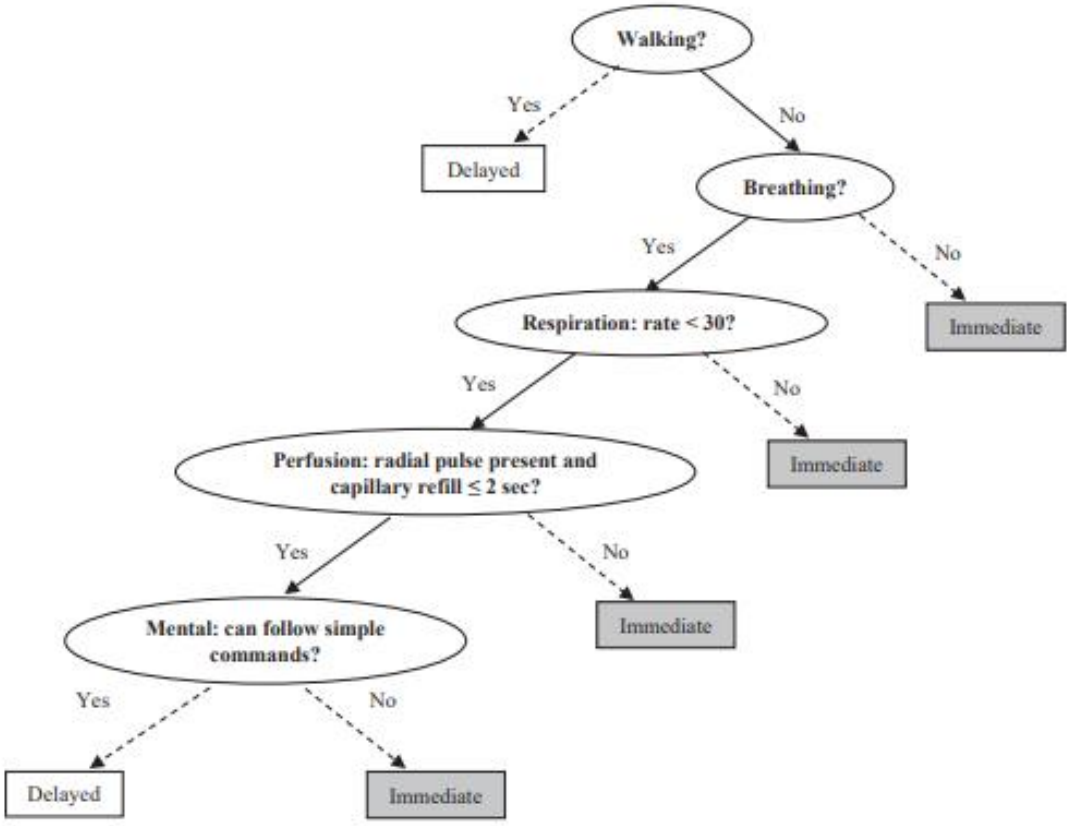
FFTs in the Broader Health Domain

In 2001, the devastating event of 9/11 (The World Trade Center Attack) demonstrated a highly practical application of fast and frugal trees in situations of time pressure. Cook (2001) reported that advanced life support paramedics and emergency medical technicians implemented the START (Simple Triage and Rapid Treatment: Super, 1984) system to quickly

assess human casualties and determine their need status. In 60 seconds or less, three cues were used to classify individual casualties as: *'deceased, need immediate attention', 'delay attention', or 'minor injuries'*. Figure 1 shows the tree (schematic representation) leveraged by the response team, which minimized casualties. Although not a scientific approach, the START technique indicates how fast and frugal trees can be advantageous in chaotic and time-pressured contexts.

Figure 1

The decision tree (schematic representation) of the START procedure (Super, 1984)



Jenny et al.'s (2013) study supports START's application of FFTs by classifying (predicting) the depression status of young women (18-25 years). A depression measure was completed at two periods (t1, t2). Response data at t1 was used to develop an FFT, while response data at t2 was used to cross-validate the FFT, simply testing the developed FFT with new information (response data) it is not adapted to. The validated accuracy of the FFT was

compared with other compensatory models that required complex calculations. FFTs had comparable accuracy scores with logistic regressions and other compensatory models despite using just 1.2 cues during model cross-validation, unlike the compensatory models that used more information (5 cues). Since early detection of depression is non-negotiable (Herbet & Cohen, 1993; Everson et al., 1998;), this finding supports Gigerenzer & Goldstein's (1996) proposition that FFTs can compete with complex models in situations of urgency and while leveraging limited information.

FFTs in the Military & Legal Domain

One of the most vivid applications of FFTs in the military domain was the study by Banks et al. (2020). The authors evaluated junior officers' comparative effectiveness and mental workload in learning and applying FFTs in a standard military task. A factorial design approach was used to develop 14 cues with the help of 6 expert military decision makers, of which just three (3) cues were integrated into an FTT design. 52 participants participated in a randomized control trial (RCT) split across two groups over two (2) periods (t1, t2). Participants in the training condition completed the task at t1 without training and with FFT training at t2. At the same time, those in the control group did likewise but without FFT training at either t1 or t2 while following the standard military procedure. Evidence was found indicating how the performance of FFT-trained junior commandants was comparable to that of non-FFT-trained officers. Participants had a true-positive rate of 78% across 3 (Attack, Defend, Withdraw) decision categories and 97% in one (Support). Interestingly, mental demand was lower in the training condition than in the control condition $F(1,52) = 4.07$, $p < .049$, $np^2 = .07$. This implies that aside from favourable accuracy, FFTs are efficient as they demand less cognitive effort.

The use of less information (cues) in a time-pressured context was also demonstrated by Dhami and Ayton (2001) in the legal domain. Magistrates often encounter massive caseloads where bail decisions are made rapidly (Dhami & Ayton, 1998) with tendencies of process and decision inconsistency (Davis & Davis, 1996). The authors studied the bail decision-making

process of 81 magistrates across 44 courts in the UK. With nine (9) critical cues in the legal-due process, the authors compared the predictability of a matching heuristic (FFT) and two compensatory models. Although all models used at least 20% of the provided cues, the matching heuristic was a better predictor of bail decisions on new cases (*Mean* = 65.61%) than the compensatory models. Interestingly, the age and race cue were used by just 6.2% of the magistrates who used the FFT. One could arguably suggest that FFTs are less biased than the legal due process, which reported inconsistency within and between magistrates' decisions in the study.

An Exception to the Application of FFTs – Engineering Domain

Contrary to the findings that supported the application of FFTs in describing the decision-making of proficient experts, Cropp et al. (2011) found that in describing the risk of environmental contamination, FFTs were less efficient. Of the three models compared, the Matching Heuristic (a type of FFT) model failed to fit the data; only a model based on social judgement theory moderately fit. This finding may suggest that FFTs might not be appropriate in domains with abundant information, requiring complex and mathematical calculations.

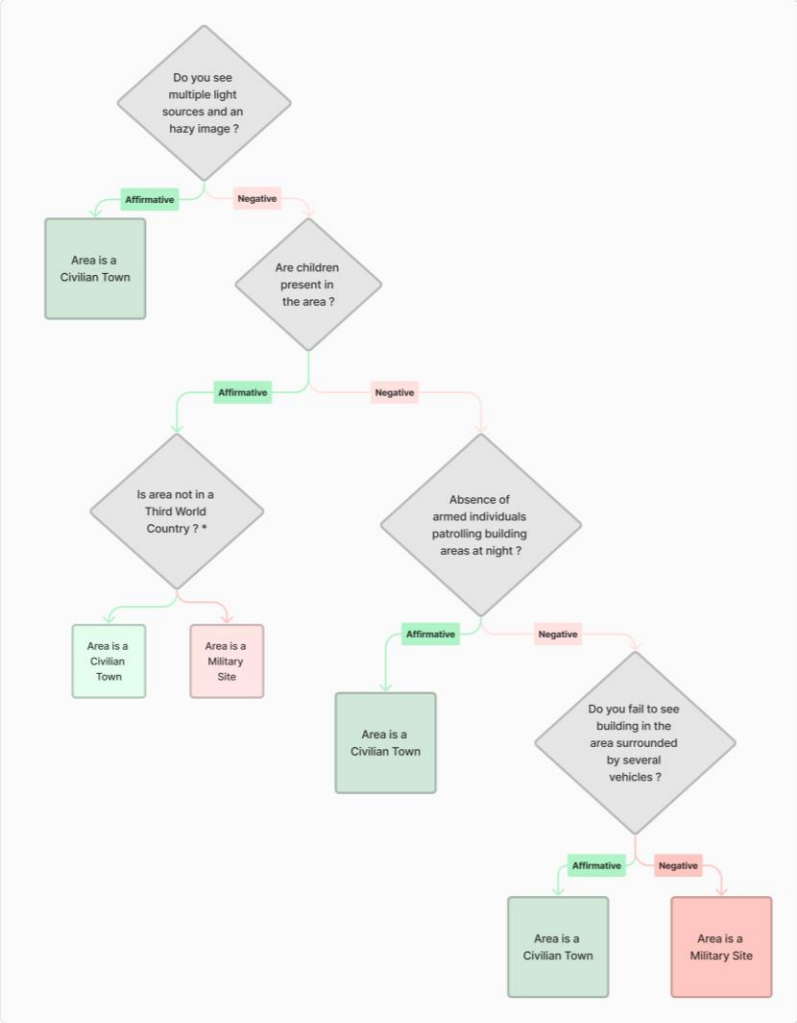
Literature has indicated that FFTs (a simple FFH categorization model) have the capacity to describe decision-making models and are comparable in the predictive accuracy of complex mathematical models in domains that are processed based and characterized by uncertainty, limited information, and time pressure. As reflected in the work of Banks et al. (2020), among other studies, the military domain can leverage this simple categorization tool to train junior commanders efficiently in classifying civilian towns and military sites. Based on the provided cues (in order of predictive power), Figure 2 illustrates a proposed FFT for the British Army.

Between April 2004 and October 2007, 21 countries or territories have been associated with the use of over hundred thousand children in armed groups and forces (Coalition to Stop

the Use of Child Soldiers, 2008). Most of these countries share characteristics of being a Third World country, hence, the proposed FFT integrated this information into its design.

Figure 2

A Proposed Cognitive Tool (FFT-based) for Civilian Town/Military Detection



Note: **The FFT was slightly modified to account for the role of country culture under the presence/absence of children cue.*

Conclusion: FFTs are Designed & Optimized for Speed, Efficiency, & Uncertainty

The present essay aims to design an FFT for the British Army to aid the decision-making of junior officers in identifying military sites and civilian towns. Studies in relevant areas highlighted the advantages of adopting the simple categorization model (Banks et al., 2020).

Kahneman et al. (1982) proposed that humans are poor decision-makers, with heuristics resulting from biased thinking. However, humans are competent decision-makers and proposed that heuristics are mental shortcuts that aid satisfactory decisions, especially in uncertain situations - characterized by time pressure and limited information (Gigerenzer & Gaissmaier, 2011).

Furthermore, literature has identified heuristics that are fast and frugal (Martignon et al., 2008) that have been applied across several domains not limited to those highlighted in this essay. This evidence highlights how these heuristics are advantageous to domains where risk cannot be assessed (Hafenbrädl et al., 2016). Since military decision-making contexts are usually marked with uncertainty, where a lack of abundant information fazes decision-makers, it is reasonable to design to adopt FFTs to simplify the complex standard sequence of decision analysis – *a feature which makes them fast*. Following Hafenbrädl et al. (2016), decisions aided by heuristics can be easily understood and effectively used. The frugality characteristic of FFTs is associated with their leverage of only the most criticsl cues (Green & Mehr, 1997), making them efficient alternatives to complex optimizations.

FFTs are also designed on three simple building blocks: *the search rule, where the model searches through cues in order of their predictive power; the Stopping rule, where the search is stopped as soon as a cue leads to an exit; and the Decision rule, where a binary classification is made accordingly* (Gigerenzer et al., 2011). Although packed with their prized features of efficiency and quickness, FFTs have a few drawbacks. One major drawback is that the FFH approach is limited to a single cue per search node. The interaction of cues is unaccounted for, which, of course, is owed to its simplicity. e.g. In the 'Are children present in the area?' node, multiple cue conditions of child absence and country culture cannot be simultaneously evaluated. Related to this is that FFT-trained junior officers would also need to differentiate between third world and non-third world countries to account for the cultural factor in the proposed FFT. Another limitation of training and using FFTs is the inability to evaluate the

decision strategy process. Only the outcomes and cognitive workload of using FFTs can be assessed. Junior officers could use other decision strategies and still encounter the same outcomes as an FFT strategy; however, Banks et al. (2020) revealed that FFTs still accounted for lower mental demand than the standard military decision strategy. Future studies should employ techniques that could evaluate decision strategy processes for reliable tests of FFTs process effectiveness.

Ultimately, evidence that decisions can be made without complex analysis in the military domain using FFH & NDM is compatible with literature across several other domains. Although FFH differs in how cues are selected and in the number of cues evaluated, it is evident that an FFT approach is a simple, fast, and efficient technique that can aid the British army's junior officers in decisions to secure civilian towns from potential military attacks with little to no expert experience.

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