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Arms Industry Student Opportunities

A Survey of University STEM Students

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Executive Summary

This study is conducted given the reality of intensified efforts of arms companies to shape the research agenda within universities, and the increasingly ripe environment being maintained for this. As results will show, there is a struggle between military and civilian sectors to claim student talent, despite the study's evidence of a strong preference for civilian work among a large share of respondents.

Previous studies of university Science, Technology, Engineering and Mathematics (STEM) student attitudes towards military work have not weighed the preferences for nonmilitary work, nor investigated the varying factors that shape these preferences. An examination of previous literature shows that individual preferences for military work can be shaped by a variety of factors. These include ethical considerations, such as views of the arms industry, and pragmatic considerations such as higher wages. This research thus adopted a survey research methodology and survey data derived via convenience sampling in order to investigate the preferences of STEM students for military/civilian work, and the influence of ethical, pragmatic, and geopolitical factors on the preference for military work.

Results found that a large minority would not do military work, but a majority of students preferred civil work over military work, given both forms of work were available. Furthermore, a lack of available alternatives is more likely to drive otherwise unwilling students to military work rather than the higher pay of military work. A preliminary analysis also revealed that the vast majority of student respondents support national policies, and specifically budgetary initiatives, which increased opportunities for employment within the civilian sector. Yet, the impact of various factors on preferences for military work often depended on the initial attitudes of the students to such work. For example, respondents most willing to do military work were more likely than those less willing to be motivated by the war in Ukraine.

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1 - Introduction

The arms trade has often been legitimised on the basis of the employment it generates and sustains. A report from the U.S Congressional Research Service, which compiles annual reports on the global arms trade, contained a statement claiming that "the principal motivation for arms sales may be based as much, if not more, on economic considerations as those of foreign and security policy" (Theoharry 2015:1). Similarly, a discursive media content analysis of two leading UK broadsheets over the course of two decades found that "benefits for the economy and employment" was the most commonly used discourse in media reports about military spending, and this discourse featured far more prominently than the discourse of "national security" (Hunt & Lewis 2011:169). Such media reports often tout supposedly positive economic and employment impacts of arms manufacturing (ibid 2011:69). On the other hand, arms manufacturers have been criticised for showing greater concern for such economic benefits than the humanitarian and moral consequences of arms exports. Such controversial arms exports from the UK include fighter aircraft used by Saudi Arabia to indiscriminately bomb civilians in Yemen (Rifkind 2017), and the licensing of components for combat aircraft, missiles, small arms and ammunition, and tanks to Israel, despite the risk of the UK being complicit in serious abuses committed by Israel that may amount to war crimes (Ahmed 2023). Yet, sustaining employment in the arms industry is often put forward as a rejoinder to such controversies (Emmons & Jilani 2016).

Arms transfers to Ukraine following the Russian invasion in 2022 have also often been legitimated on the basis of the employment generated from such transfers (Lemire, Haberkorn 2023). The war has drastically increased demand for weapons orders from arms companies in the U.S. and Europe, but arms companies are struggling to meet the accompanying increase in employee demand since, among other factors, "some people have qualms about working for arms makers" (Cameron & Macdonald 2023). The workforce for the arms industry is often recruited from science, technology, engineering, and mathematics (STEM) disciplines, and the UK, along with countries such as the U.S., is supposedly affected by a shortage of STEM personnel in the arms industry and wider economy. This perceived STEM shortage has also heightened fears within the arms industry in the UK of being outpaced by foreign competitors (Turner 2022), so the STEM shortage is seen as not only potentially compromising defence and security goals in the future, but also the commercial viability of the arms industry. Therefore, a key imperative of the military-industrial sector is to boost recruitment of STEM personnel.

The military-industrial sector has launched several initiatives to boost STEM recruitment, which are often targeted at youth from STEM disciplines. Arms companies such as BAE Systems operate education outreach programs from the primary to the higher education level to encourage young people to pursue careers in engineering and technology with the company (BAE Systems n.d.). The Ministry of Defence (MOD) has launched initiatives to boost STEM recruitment, including the STEM graduate inflow scheme (SGIS) (UK Parliament 2019), and Defence STEM Engagement, which links with initiatives from the Department of Education and Department for Business, Energy and Industrial Strategy to

address the STEM shortage (GOV.UK 2016). University students from STEM disciplines are often recruited for work in the military-industrial sector. Despite this, university students have often been left out of these debates and discussions. This report will hence investigate the extent to which STEM university students want to do military work, as well as the extent that this preference is affected by external factors such as availability, wages, the war in Ukraine, and unethical arms exports. The report will also investigate the degree of support among STEM students for an expansion in nonmilitary or civilian employment.

Background

1.1 STEM Recruitment from Higher Education

Higher education has been a focal point for recruitment efforts by arms companies. As universities have become increasingly commercialised, they have been met with growing expectations to generate an employable workforce for various industries, including defence (Langley, Parkinson & Webber 2008:7). Arms companies therefore invest in universities with the anticipated return of generating this employable workforce for the arms industry (Stavrianakis 2009:10). Arms companies recruit university students through open events such as career fairs held on campuses, but also more covertly through academic, strategic, and research partnerships with universities. In 2016, the University of Gloucestershire formed a strategic partnership with the U.S. arms company, Raytheon (now RTX), to "provide three third year undergraduate bursaries to students at the university, with conditional job offers on graduation" (University of Gloucestershire 2016). In 2023, two major UK aerospace and defence companies, Cobham and Ultra Electronics, announced a scholarship programme that pledged £5 million to six UK universities to support more than 100 students beginning their studies in 2023, and open the possibility for students to "explore work opportunities and even a year in industry" (ULTRA 2023). Finally, in 2024, the University of Portsmouth and BAE Systems launched the first ever degree apprenticeship in Space Systems Engineering in the UK, which is also intended to address "the critical challenge of a skills shortage", according to the Executive Dean of the Faculty of Technology in the university (BAE Systems 2024).

1.2 STEM Shortage

Despite such efforts, the military-industrial sector is struggling to recruit STEM professionals. This difficulty is compounded by the decline of arms-related employment since the early 80s from 740,000 to 315,000 in 2006 (Schofield 2008:4). Additionally, the arms industry, along with the wider UK economy, has been argued to be negatively impacted by a long-term "STEM shortage" in the workforce. Concern has been raised by the "triple helix" of industry, government, and universities over the difficulty of attracting students to STEM careers (Smith & White 2018:27). This shortage has driven the military to resort to several measures, occasionally dramatic, to attract STEM talent. In 2005, the U.S. military paid scientists to attend a screenwriting course for producing movies with flattering portrayals of scientists (Halbfinger 2005). The purpose of this initiative, which was conceived by a professor in electrical engineering from the University of Southern California, was to boost student interest in science and engineering in order to address the decline of

such professionals in the military (ibid 2005). In 2019, the UK government introduced a new immigration route for international students which extended their stay in the country up to two years after graduation, and this change was especially intended to address the STEM shortage in the UK (Lindsay 2019).

However, some arms companies have made some progress in recruitment in recent years. BAE Systems for example in the past five years doubled its early careers intake (Macpherson 2023). In 2021, Rolls Royce offered a record number of positions in its apprenticeship programme (FE News 2021). Apprenticeships have been discussed by the MOD and industry as a means through which skills can be developed without the need for university degrees (Ministry of Defence 2023), which can ease reliance on universities for recruitment. Despite such seeming headways in boosting recruitment, warnings have continued to be issued of a STEM shortage in the military-industrial sector in the UK. Guidant Global, which provides workforce management solutions, released a report, in collaboration with Defence Online, in 2024 that argued that the military industrial sector was experiencing a shortage in critical STEM skills, and this shortage was felt most notably in fields such as engineering and cyber & digital (Forrester 2024).

On the other hand, the perception of a STEM shortage in the economy has been contested. In the U.S., it has been argued that there is little evidence to substantiate this claim (Hira 2022:31). Additionally, a 2018 study published in the UK, defined as the most comprehensive account of participation along the UK STEM pipeline, found little evidence of a shortage of STEM professionals in the UK, but also found that most STEM graduates do not work in high-skilled STEM jobs (Smith & White 2018:26). The authors claim that if only a minority of STEM graduates go into high-skilled work following graduation, then it is possible that, contrary to there being a shortage of STEM graduates in the UK, there may instead be a shortage of STEM graduates who want high-skilled STEM positions (ibid 2018:30). The military-industrial sector has long been distinguished as a high-skilled industry (Thee 1988:61), so investigating the extent to which STEM graduates want to work in this sector can contribute to this debate over the STEM shortage. Additionally, studies have called for student views to be better represented in discussions of a perceived STEM shortage (Hira, 2022:31). Research has been conducted that does represent student views towards STEM careers. However, as the following section will illustrate, there has been less studies investigating the attitudes and preferences of STEM students towards military and civilian careers. Conclusively, the military-industrial sector may be genuinely struggling to recruit STEM graduates, but it is unclear to what extent this struggle is attributable to a “shortage” of STEM graduates, or a low willingness among STEM graduates to work in the military-industrial sector. Investigating the perceptions of STEM students towards work in the military-industrial sector can therefore contribute to resolving these uncertainties.

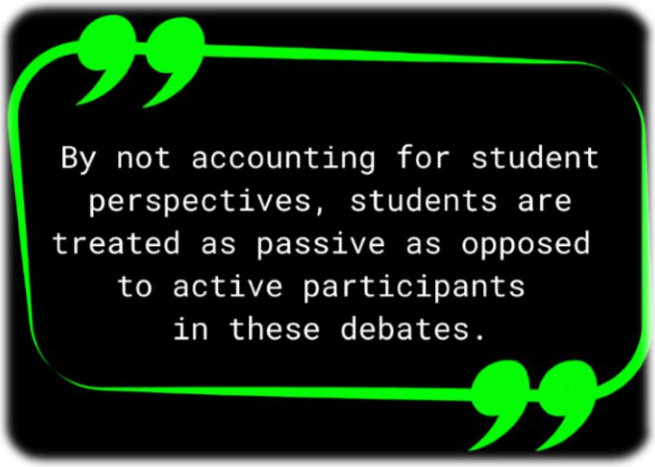
The report is structured as follows:

- Chapter 2 critically evaluates previous research on the attitudes of youth and STEM graduates towards STEM careers in the military-industrial sector. The review identifies gaps in this research, and then shows how research on attitudes of workers from the arms industry offer insights that can fill these gaps. This section

will show how this study bridges the gap within and between research on STEM student attitudes and research on military worker attitudes.

- Chapter 3, the theoretical framework, describes the factors affecting preferences for military work that will be investigated for the survey. These factors will further investigate how students can weigh their preferences for military work with civilian work, pragmatic and material factors such as wages, perceptions of the war in Ukraine, and arms exports.
- Chapter 4 provides the research strategy and methods for the study, which describes how the data will be collected. The section also describes limitations of the study.
- Chapter 5 presents results and analysis from the questionnaire.
- Chapter 6 provides a discussion of the need for further survey and interview research in order to account for wider sampling methods, and factors that can influence such preferences explored in this study such as geopolitical crises, demographic considerations, and proximity to arms-manufacturing sites. This is then followed by the conclusion.

Contributions



The limited research into student attitudes towards military careers undermines the empirical basis of public debates over student recruitment by the military-industrial sector. Also, ignoring student views also undermines the accountability and legitimacy of universities that promote military careers to their students.
Universities that extol the virtues of careers with the military-industrial sector often don't invoke student attitudes towards such careers, which is significant given the significant controversy and questionable ethics of such employment. By not accounting for student perspectives, students are treated as passive as opposed to active participants in these debates. Yet students are relevant to these discussions not only due to current STEM students being future military workers, but also due to students being one of the key stakeholders in education more broadly. This study therefore contributes to student representation in these debates and discussions.

2 - Literature Review

2.1 STEM Student Views of Military and Civilian Careers

Previous studies have investigated the preferred company destinations of STEM students. Universum, an employer branding agency, conducted a poll from September 2022 to March 2023 asking engineering students in particular from the U.S. to list their five ideal employers (Hoff 2023). Lockheed Martin, the largest arms company in the world, was ranked as the top company engineering students desired to work for at 20.6% (ibid 2023). General Electric (GE), RTX, Northrop Grumman, and Boeing were other arms companies that were ranked in the top 20 companies from the survey (ibid 2023). Additionally, Handshake, a U.S.-based college career site, produced a report that found that arms companies such as RTX and Lockheed Martin saw some of the biggest increases in searches by the graduating class of 2023 (Handshake 2023). However, unlike the Universum survey, the Handshake report does not specify the graduate subject origins of such increased interest in these arms companies. Despite this, and taken together, these studies would appear to indicate growing interest in careers with arms companies.

On the other hand, such studies offer little clarity as to whether students that wish to work for these companies would like to do military work specifically, since the preferred company destinations of STEM students may not necessarily be a proxy for the preferred work roles of STEM students, even if such companies originate from the arms industry. For example, with Lockheed Martin drawing 96% of its revenue from defence, it is likely that most students that wish to work for Lockheed have few issues with military work, but contrary to this, companies such as GE only derive 6% of their revenue from defence, and RTX, despite being the second largest arms company in the world, derives 59% of its revenue from defence (Defense News 2023). Therefore, an interest in working for an arms company may not necessarily translate into a preference for military work, since arms companies differ regarding the proportion of production and revenue they derive from military sales. Thus, some respondents may prefer being engaged with civilian production while working for an arms company, which is particularly likely in companies with a more diversified portfolio. Due to this, in order to uncover STEM preferences for “military” work, more clarity can be provided by asking students if they would like to do military work specifically rather than only asking whether they would work for an arms company or in the military-industrial sector.

BFBS, an agency founded to aid and alleviate communication challenges faced by the UK armed forces and government, conducted an online survey of 1,000 Gen-Z youth interested in STEM roles that builds upon these previous studies in several ways. First, unlike the Universum survey, this survey inquired into the preferred company destinations of not only engineering students, but students interested in all STEM disciplines. Secondly, unlike the Universum survey, BFBS also investigated youth perceptions towards work in the armed forces and factors that affect those preferences (BFBS Creative 2021:3) This survey also investigated factors that shape Gen-Z’s thinking of new STEM careers in general. In contrast to the Universum survey, technology companies were found to be the top industry

respondents proactively mentioned wanting to work for, with Google dominating the rankings at 18%, but the NHS was ranked second at 11% (ibid 2021:6). Separate from this, 19% of respondents expressed an interest in pursuing a STEM career in the armed forces, but this increased to 34% when respondents were presented with STEM roles available in the armed forces, and 41% were found to be unaware of such available opportunities (ibid 2021:8). The study therefore suggests that not being made aware of STEM roles in the armed forces can undermine the preference to work for the armed forces. Finally, reasons given by youth uninterested in a career in the armed forces included the ethics of working for the armed forces, feeling unwelcome and uncomfortable, and being away from family (ibid, 2021:8).

Yet, the BFBS study also contains a few limitations. Firstly, the study finds that 31% of respondents believed the armed forces offers good pay and benefits and pay and benefits were included among the most proactively cited benefits of work in the armed forces by respondents who expressed an interest in such work (ibid 2021:9). But, the study did not investigate the extent to which pay, and benefits made the youth uninterested in a career in the armed forces more willing to pursue such a career. Offering such insight can be valuable for investigating the extent to which higher wages can lure otherwise-reluctant STEM graduates into the armed forces. Secondly, the study did not account for how the youth weighed preferences for work in the armed forces with civilian work. The study hence did not determine how much of the 19% who would consider work in the armed forces preferred such work to civilian careers if they were offered a choice between the two. As the following section will reveal, studies carried out of workers in the arms industry have filled in some of these gaps in the literature of STEM student attitudes towards military careers.

2.2 Views of Military Workers Towards Military and Civilian Careers

Studies of conversion and diversification have often served as the main topic of investigation for several studies that provide data of military workers' views towards military and civilian careers. Conversion refers to partly or completely turning military industries and firms into civilian ones, while diversification refers to a firm entering into a very different business field without abandoning its original business field (Southwood 1991:8-9). One study surveyed the attitudes of workers based in Barrow towards conversion and diversification, covering four unions based at the former shipbuilding company Vickers Shipbuilding and Engineering Ltd (VSEL) (Schofield, Southwood, Woodhouse 1988:175). In contrast to the BFBS study, this survey asked the workers whether they preferred military work, civilian work, or held no particular preference. Only 4% of respondents expressed a preference for military work, while 35% expressed a preference for civilian work, and the majority expressed no preference for either kind of work (ibid 1988:176). Additionally, the study found that the workers expressed twice as much support for diversification than they did for conversion (ibid 1988:176). Despite this, the study found that a strong majority, at 73%, supported an expansion of civilian work and a pilot project to develop more civilian products (ibid 1988:176).

Another study titled *Decarbonising and Diversifying Defence in the United Kingdom and United States,* by the British Academy, employed qualitative methods to interview a sample of workers in the military-industrial sector concerning diversification and a "just transition",

defined as securing the rights, livelihoods, and community well-being when shifting away from work in the military-industrial sector and towards green and sustainable production (Bell et al. 2022:4). The report found that some workers felt that a change towards green jobs would need to be proportional to the pay and status they previously derived from their work in the military-industrial sector, so the higher pay from military work posed a challenge to designs of green jobs (ibid 2022:14). However, the report also found a cohort of workers that preferred civilian work to the work they were currently doing for the military-industrial sector (ibid 2022:12).

A previous study tested this assumption linked to higher wages through questionnaires. This study, which was funded by the Economic and Social Research Council (ESRC), interviewed personnel managers and directors in the arms industry, and adopted questionnaires as a method to collect opinions from a large sample of military engineers and scientists. In contrast to some findings in the interview data and BFBS survey, most of the surveyed engineers and scientists did not prefer military work because the pay was higher than that in the civilian sector, and economists or accountants employed in the arms industry were cited as more likely than engineers or scientists to value higher pay (Lovering 1991:105). The differences in these findings illustrate the utility of testing assumptions found through interview data through questionnaires. While the interview data showed that certain workers felt that higher pay from military work inhibited conversion or a green transition, the survey data showed that the scope of such attitudes may be low. Also, the ESRC-funded study shows the limits of using arms companies as an indicator for military work. As stated by one of the managers interviewed, arms companies who were significantly engaged in civilian markets held an advantage in recruitment due to also offering prospective applicants civilian work (ibid 1991:105).

In addition, the ESRC-funded study found that surveyed engineers were often drawn to military work for intrinsic reasons, such as the genuine enjoyment that some workers derive from work on such military projects (ibid 1991:105). Intrinsic reasons in favour of science and technology are often counterposed to reasons based on social responsibility, which together do not necessarily describe how science is practised but how it ought to be practised. According to the former, the scientific profession ought to be based on the pursuit of knowledge for its own sake and the internal concerns of the scientific community, and this standard has often been applied to demarcate science from other fields of inquiry, such as journalism, whose agenda is presumably more driven by external concerns (Carlshamre 2022:39). On the other hand, according to the standard of social responsibility, scientists ought to avoid harm and pursue knowledge for the welfare and benefit of others (Forge 2008:155). Being drawn to science for intrinsic reasons may account for the surveyed engineers not preferring military work for reasons linked to high pay, which may also suggest that the preferences of such scientists may be less affected by external factors. Such intrinsic motivations however may include feeling less responsible for the impact of such military work on others.

Collectively, these studies investigate the views of workers already employed in the military-industrial sector. As such, they don't offer insights into the views of those who are eligible or considering careers in the sector. For instance, these studies on workers can't offer insights as to the potential impact of being approached for military work on

preferences for military work. Also, the literature shows ambiguity over whether the higher wages of military work shapes preferences for military work, but this literature, similar to the BFBS survey, does not account for the extent to which higher wages can lower resistance to military work. Uncovering such information can be relevant for assessing the potential impact of various factors on leading STEM professionals into military careers in the first place.

Synthesis

This study aims to bridge certain gaps within and between literature on STEM student attitudes towards military/civilian careers and literature on worker attitudes towards military/civilian careers. Firstly, to gain more detailed insight into the scope of interest in military careers, unlike the Universum survey and BFBS survey, this study will not ask what employers STEM students wish to work for, but whether they want to do military work specifically. This will constitute the main "effect", or dependent variable, under investigation. Secondly, this research will go beyond the BFBS survey by not only investigating the extent to which STEM students want to do military work, but by also posing the kinds of questions that were posed in the Barrow survey to STEM students. This entails not only asking students if they would do military work, but how they rank different kinds of work. Third, this study will test the impact, found in the BFBS survey, interview data, and survey data of military workers, of external factors such as higher wages in shaping preferences for the different kinds of work. However, this study will also go beyond these studies by investigating the impact of additional external factors on preferences for military work. For example, as previously discussed, the war in Ukraine has given a powerful impetus to the military-industrial sector to boost recruitment, but the extent to which students have been similarly invigorated by the war to do military work has not been investigated. Finally, similar to the Barrow survey, this study will also investigate the extent of support for the expansion of civilian employment opportunities. Prior to outlining the various factors that will be tested for this study, the following section will describe the relevance and implications of addressing these gaps in the literature.

Implications

> By similarly investigating student preferences for military work, and factors that shape those preferences, peace campaigners can also tailor their messaging and outreach to the preferences and views of STEM students in universities.

There are potentially serious implications in not addressing the gaps in this literature. Respondents who are averse to military work, and prefer civilian work, may face challenges in finding STEM roles to accommodate these preferences. The military-industrial sector is increasingly appropriating technology developed from the civilian sector for military purposes, in a process that has been described as the growing "spin-in" of dual -use technology, which are technologies with military and nonmilitary applications. Such spin-in is part of a growing military emphasis on

"emerging and disruptive technologies" (EDT). EDTs, such as artificial intelligence (AI), are predominantly driven by investments from the civilian and commercial sector. This development is an outcome of the leading role of the civilian and commercial sector in pioneering and investing in state-of-the-art technology; many of which are then adapted for military use.

Due to this, STEM students that prefer civilian work or tech companies such as Google may nevertheless be drawn into military work, since such nonmilitary companies are increasingly developing technologies for military use, which has been conceptualised as "the militarisation of big tech" (González 2023). The case of Google illustrates these challenges. As shown by the BFBS survey, Google was the most commonly mentioned company STEM youth proactively mentioned wanting to work for. However, Google, similar to major tech companies such as Microsoft, has collaborated with the military for developing technologies for military use. Following employee protests, Google abandoned work on a Pentagon program titled Project Maven, which sought to employ AI to improve the targeting of drone strikes (Wakabayashi & Conger, 2021). However, three years later, Google, along with Microsoft and Amazon, then pursued a contract for the Joint Warfighting Cloud Capability (JWCC) from the Pentagon (ibid, 2021). While the contract is intended to enable "generic" uses of AI not linked to weapons and surveillance, per Google's AI ethical guidelines, it is unclear if the contract will follow these principles since the Pentagon expects the technology to support combat operations (ibid, 2021).

Case studies such as Google and the JWCC illustrate the challenges that lie ahead for STEM graduates and professionals that wish to avoid military work. The case study of JWCC also illustrates the limitations of the BFBS survey not asking the STEM youth who mentioned Google as a favourable employer whether they preferred military work or civilian work. STEM youth who would do military work or have no clear preference for either kind of work, may have little consternation with oscillating between civilian and military work and working with Google and the JWCC, but STEM graduates who shun military work, and prefer civilian work may experience greater discomfort working for Google and the JWCC. Additionally, as suggested by the Barrow survey and interview data, even STEM professionals who would be open to military work may ultimately prefer civilian work. Therefore, accounting for how STEM students rank the different kinds of work can offer more clarity and nuance to these discussions.

This study is also relevant for identifying the relative influence of certain factors in shaping STEM student preferences for military work, which can be used to improve communications and outreach by individuals, groups, and campaigners who wish to encourage students to pursue civilian careers. As an agency intended to address communication challenges of the UK armed forces, findings from the BFBS survey illustrate how survey research findings can be useful for shaping effective communications. The BFBS survey found that 64% and 62% of respondents respectively believed that a work-life balance and flexible working hours had grown in importance since the pandemic, but 52% of respondents believed the armed forces offered a good work-life balance (BFBS Creative 2021:11). Due to this, one of the recommendations from the BFBS survey was for recruitment campaigns to emphasise flexible working hours and a work-life balance in order to boost STEM Gen-Z recruitment into the armed forces (BFBS Creative 2021:11). The

University of Southampton has incorporated this messaging for a recruitment programme currently being undertaken in partnership with the military-industrial sector. This programme, which is titled the Defence and Security Mobility DTP, aims to increase the number of doctoral-level students employed in the military-industrial sector (University of Southampton n.d.). Among the advertised benefits of the programme is a "flexible approach to ensure a balance between work, life, and study commitments" (ibid n.d.). Regardless of whether or not this messaging was directly inspired by the BFBS survey, the fact that the messaging is supported by survey research can make it effective for recruitment.

Additionally, the BFBS study also found that Gen Z perceptions of the armed forces were mostly informed by the media at 82%, while films and TV shaped the perception of 34% of the respondents (BFBS Creative, 2021:9). This would render the U.S. military's previous efforts, as previously described, to improve the image of scientists in film, as a means of boosting STEM recruitment, relatively less effective than utilising other media. However, this finding also alludes to the significance of the previously mentioned study which found that "benefits for the economy and employment" was the most commonly used discourse in UK media reports of military spending. If Gen Z perceptions of the armed forces are overwhelmingly shaped by the media, and the majority of media reports of military expenditure promote economic and employment benefits of military spending, then such media reporting can significantly shape how Gen Z perceive military work.

By similarly investigating student preferences for military work, and factors that shape those preferences, peace campaigners can also tailor their messaging and outreach to the preferences and views of STEM students in universities. The following section will outline such factors that will constitute the theoretical framework for the investigation of STEM student attitudes towards military work.

3 - Theoretical Framework

This study will investigate the extent to which STEM university students in the UK want to do military work. For the purposes of this study, military work is defined as "work for defence firms, military-serving laboratories, and activities that directly promote military research, innovation, or production". This definition highlights the "military" nature of activities conducted under the military establishment and arms industry, which transcends the limitation of only asking whether students wish to work for defence firms or military-serving laboratories. Additionally, as previously mentioned, this study investigates the extent to which preferences for military work are affected by the external environment, which departs from previous studies, such as the BFBS report, which asked students to proactively mention their preferred company destinations as well as the qualities that STEM graduates seek in potential employers. This section will outline the framework of external factors whose impact on preferences for military work will be investigated.

3.1 Preferences and Availability

As discussed, the Barrow survey ranked military workers' preferences for different kinds of work. The survey showed that many workers employed for military work actually preferred civilian work or held no particular preference. Similarly, several workers in the military sector from the interview research preferred civilian and green jobs. While the reasons for their current employment in the military-industrial sector were not given, it can be inferred from such views that some workers would preferably be employed by the civilian sector if such work were as accessible as military work, and that some workers may find themselves in their current line of work due to an inability to find alternatives. Hence students who would prefer military or civilian work may put aside their preferences if opportunities for their preferred work role are unavailable. Respondents can therefore be asked which type of work they prefer, assuming such work were equally available to them. However, given the greater controversy and problematic ethics of military work, respondents who prefer civilian work will also be asked if they would do military work if they were unable to find civilian alternatives.

3.2 Wages

Previous literature also showed that the higher wages in the military-industrial sector were cited by some military workers as a factor to be accounted for in transitioning to civilian work. Wages in the arms industry are estimated to be 16% higher than the UK mean average annual full-time salary in 2020 (GOV.UK 2022). However, as also previously shown, survey data showed that many workers in the arms industry do not place much value in high wages from military work. Additionally, previous literature did not clarify the extent to which those who would not do military work would be drawn into such work by the prospect of higher wages, despite misgivings with the military-industrial sector. As quoted from a journalistic report of arms company recruitment in U.S. college campuses, the lucrative wages from the arms industry "drives a lot of your moral disagreements with defence away" (Olivier 2022). STEM students that express a preference for civilian work may hence be drawn by the prospect of higher wages to military work. Also, this study will also ask whether those who prefer military work would switch their preferences if they were offered higher pay for civilian work. The previous chapter showed ambiguity in the literature concerning this factor's impact, as many respondents in the BFBS survey cited the higher wages from STEM roles in the armed forces as an attractive feature of such work, while the survey of engineers showed that few cited higher pay as a reason for their preference for military work. Yet, as also stated in the survey of engineers and scientists, a high proportion still cited "better pay" as the most attractive characteristic of alternative job prospects (Lovering 1991:103). By investigating whether students would switch their preferences if civilian work paid more, this study could gauge the relevance of wages in shaping the preferences of those who prefer military work.

3.3 War in Ukraine

As previously discussed, the war in Ukraine from 2022 is the central geopolitical context behind increased drives to recruit STEM professionals and graduates for military work. The war may have hence caused a strong shift in attitudes in favour of military work. For example, as previously discussed through the case of Project Maven and Google, employees in tech companies have often protested military contracts, however, tech

companies have become more open to such contracts due to the war and subsequent renewal of great power conflict (Sabin 2023). This shift would be consistent with polling data which has found an increase in public support for several military policies in the aftermath of the invasion. For example, after the invasion, UK polls found an increase in opinion in favour of replacing the Trident nuclear missile system for an equally powerful system, and a decline of opinion in favour of giving up Trident (Salah 2022). Notably, this shift occurred despite those being polled being made aware of the costs of replacing Trident (ibid 2022), which is significant since previous polling has often found that the public reconsiders replacing Trident when presented with the costs of doing so (Ritchie 2015:154). Such polling results hence illustrate the magnitude of the shift of opinion in places such as the UK in favour of military policies. STEM students may have similarly shifted strongly in favour of military work following the war. This study will hence investigate the strength of this factor in shaping preferences for military work.

3.4 Evidence of Arms Exports to Human-Rights Abusing Regimes

On the other hand, efforts to recruit workers can be stymied by the ethical perception of the arms industry, and the controversial ethics of such work is often embodied in the international trade in conventional arms. A poll from the UK found that 62% opposed arms sales to undemocratic countries (Smith 2017). Yet the UK has exported arms to two thirds of countries classified as “not free” according to Freedom House, who often use these exports to abuse human-rights (Townsend 2021), and this, along with deadly uses of arm exports, as previously described, has made the arms industry an object of significant controversy. Investigating whether student preferences are affected by such exports can hence determine the extent to which students are affected by the problematic ethics of the arms trade. Due to this, if students were similarly aware of such unethical exports, they may be much less willing to do military work. Students will hence be asked if hypothetical knowledge of arms exports to human-rights abusing regimes would affect their preferences for military work.

3.5 Approach from Military/Civilian Recruiters

The BFBS study showed that being made aware of STEM roles in the armed forces can increase the willingness to do military work. Due to this, the extent to which students have been approached for employment by military or civilian recruiters can correlate with their preferences for either kind of work. Therefore, STEM students will be asked if they have been approached by recruiters from both sectors, and these responses can be compared to their willingness to do military work in order to uncover a possible correlation between being approached for both kinds of work and a willingness to do military work. For example, groups that have been offered more opportunities for civilian and green employment than military work may be less willing to do military work.

3.6 Support for National Budgetary Policies to Expand Civilian Employment

Apart from only asking students about the impact of these external factors, this study will also investigate the extent of support for an expansion of civilian employment. As shown by the Barrow survey, while the majority of respondents held no preference for civilian or military work, the vast majority supported an expansion of civilian work. Similarly,

this study will investigate the extent of support for budgetary policies made at the national level to increase civilian work. Similar to the previous question, responses to this question can be compared with the willingness to do military work as well as preferences for military/civilian work in order to determine correlations.

Synthesis

Most of the factors above constitute different kinds of external factors. Recruitment concerns the extent to which students are offered military/civilian jobs. Wages concern material incentives, and the war in Ukraine and arms exports concern the "foreign" activities of arms companies, and arms exports in particular represent ethical considerations of the arms industry. The study can hence reveal how students balance ethical considerations such as unethical arms exports with pragmatic and material considerations such as higher wages.

By investigating such external factors, the study can provide insight into the flexibility and "vulnerability" of these preferences i.e. the vulnerability of such preferences to material incentives such as higher wages and geopolitical factors such as the war in Ukraine. This departs from previous studies covered in the last chapter, on engineering and STEM students, which simply asked for favoured employers and whether they would perform STEM roles in the armed forces, but didn't inquire into material and ethical factors that may affect these preferences e.g. would the engineers who cited Lockheed as their favoured employer still wish to work for the company, in a military-serving capacity, if they were presented with evidence of arms exports to human-rights abusing regimes?

The study can also determine which groups are more vulnerable to certain external factors, e.g. does higher wages equally shape the preferences of those who prefer military work and those who prefer civilian work? By gaining insight into the flexibility of these preferences, this study can determine the extent to which military-industrial recruitment can be, and has been, disrupted or encouraged by factors linked to the external environment. For example, if evidence of arms exports to human-rights abusing regimes powerfully shapes preferences for military work, then campaigners can employ such evidence to significantly disrupt arms company recruitment. However, if such knowledge makes little difference to such preferences, then the use of this evidence would make little difference in disrupting recruitment. This outcome relates to implications for messaging and outreach, as discussed in the previous chapter. The following chapter will provide the method of investigation and the model for operationalising the framework provided above.

4 - Method

This study adopts a survey research methodology, defined as "the collection of information from a sample of individuals through their responses to questions" (Check & Schutt 2012:160). This study executed this methodology through the method of questionnaires with multiple choice responses. The larger group or population under

investigation are STEM university students studying in the UK. To investigate this group, a sample, or subset of the population had to be extracted. Due to time and resource constraints, this study drew its sample from the population through convenience sampling, which is a non-probability method frequently used in social research that selected participants on the basis of their accessibility for the research, which entailed that participants from the population were not randomly selected (Bryman et al 2021:176).

An incentive of £100 was offered for respondents willing to provide an email address, entered into a random lottery draw. Incentives are tools that can be employed in research to boost and speed up response rates (University of Oxford n.d.). The questionnaire was distributed online to STEM student societies in UK universities. Given the broad military applications of STEM, societies selected for distribution covered the whole range of natural science societies in different universities, including engineering, medicine, physics etc. Publicly available contact details for STEM student societies were used to request the completion of the questionnaire and its distribution to student society members and other interested STEM students. By requesting, via email, that the relevant contacts from these societies pass the link to the questionnaire to members of their society or other STEM students who may be interested, this study also employed snowball sampling, which is linked to convenience sampling, and based on utilising initial contact with a study-relevant individual or group to make contact with other groups relevant to the investigation (ibid 2021:177). If available, the survey was also distributed directly to student societies through platforms such as WhatsApp and Discord. The survey was also distributed through the online network, Reddit. Posts were created on different subreddits dedicated to STEM fields such as engineering, as well as all the subreddits for different universities in the UK. The survey specifically invited STEM students in UK universities to participate, however, there were few respondents who did not meet this requirement, so such responses were removed from the survey.

4.1. Survey Design

The questionnaire was designed and disseminated using Monday.com, a work management platform. This questionnaire only applied closed-ended questions, which presented respondents with multiple fixed options to choose from (ibid 2021:237). Since this study is investigating attitudes towards work in the military-industrial sector, the options were organised with use of a likert scale, which, contrary to applying a binary distinction by asking respondents whether they approve or disapprove of a topic, measures the intensity of attitudes towards the topic (ibid 2021:235). Hence, contrary to using a two-item scale by asking if respondents “would” or “would not do” military work, the responses to the questions were ranked through a four-item scale beginning, for example, with “Definitely” and ending with “Unsure, prefer not to say”. Positions such as “unsure, prefer not to say” often indicate uncertainty and neutrality towards the subject (ibid 2021:152), hence this response was included in all the questions in the questionnaire.

General questions often precede more specific questions in surveys (ibid 2021:201). Since the main “effect”, or dependent variable, under investigation is the extent to which students would do military work, this constituted the first and most general question, as shown below:

Would you work for defence firms, military-serving laboratories, or engage in activities which directly promoted military research, innovation, or production, i.e. military work?

1. *Definitely*
2. *Maybe*
3. *No*
4. *Unsure, prefer not to say*

The respondents were then subdivided according to how they answered this first question. The following questions hence tested the influence of the factors listed in the previous chapter on these separate values for preferences for military work, e.g. respondents were asked whether evidence of arms exports would affect their preferences for military work, and answers were compared between respondents who would definitely, maybe, and not do military work. As the presentation of results will illustrate, no respondents were included in the "unsure" category. Answers to the remaining questions continued to be organised on a scale which differentiated the intensity of attitudes.

4.2 Limitations

As previously stated, this study used convenience sampling to sample the population. A strong limitation of this method is that it can yield sampling bias (ibid 2021:176). The results of the survey hence cannot be generalised towards the wider STEM student body in the UK. However, this sampling procedure ultimately offered the strongest access and availability to university students for the study. This sampling procedure also implies that findings from the survey can be regarded as hypotheses that can be further investigated in future studies that employ probability sampling.

Probability sampling ensures greater generalisability since students in the population have an equal chance of being selected for the survey (ibid 2021:174). Ordinarily, probability sampling can be enabled by access to a sampling frame, which lists all the units from which a sample will be extracted for the research (ibid 2021:167). An example of a sampling frame that could be used for future studies are university student mailing lists, which are often grouped according to graduate level and department. Future studies can hence gain access to university mailing lists for STEM departments. However, access to such mailing lists for this study was complicated by such lists often only being available for use by staff or students in universities. This limited access to university students, which in turn raised the utility of convenience sampling, since convenience sampling is advantageous precisely due to the access it provides to difficult-to-reach populations (ibid 2021:177), such as university students in this case. Researchers that are able to gain access to such a sampling frame however can use it to employ probability sampling.

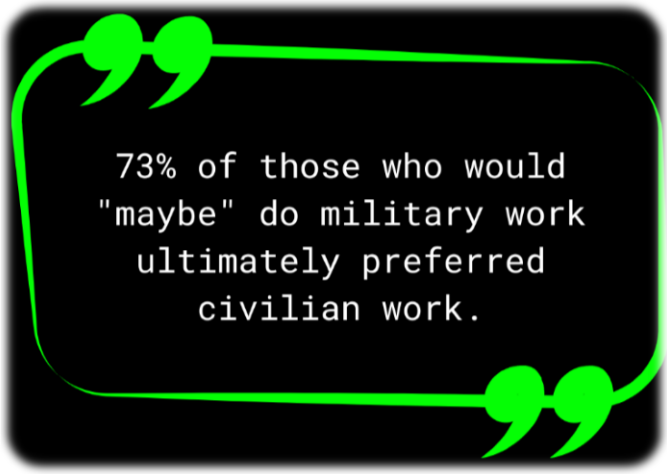
5 - Results & Discussion

This chapter provides responses to the questionnaire. Prior to presenting these results, a demographic breakdown of the respondents will be presented. Attempts were

made to include more diversity amongst respondents, such as by sending the questionnaire to STEM student groups specifically for women, ethnic minority, and LGBTQIA groups. However, the demographic responses revealed that 21% of the respondents identified as female, 65% as male, 8% as non-binary/nonconforming, and 2% as transgender. 4% preferred not to say their gender identity. Regarding ethnicity, 70% identified as White, 13% of respondents as Asian or Asian British, 2% as Black British or Black Caribbean, 8% as Mixed, 4% as Other, and 3% preferred not to say their ethnic identity. 78% of the respondents were in the 18-26 age range, 14% were in the 26-35 age range, 6% were in the 35+ age range, and 1.34% did not specify their age. Finally, regarding student status, 78% of respondents were students at the undergraduate level, 15% were at the postgraduate research level, and 7% were at the postgraduate student level. As shown by this demographic breakdown, most of the respondents skewed towards being white, male, in the 18-26 age range, and at the undergraduate level.

The universities that generated the highest responses were, in order, Glasgow University (8.7%), Open University (8%), the Universities of Sheffield and Lancaster (each 7.4%), Bristol University (6%), the universities Oxford University and Imperial College London (each 5%), the University of Strathclyde (4%), the Universities of Manchester, Nottingham, and York (each 3%), the universities University College London, Heriot-Watt, and Southampton (each 2.7%), Queen Mary University of London, Queen's University Belfast, and Kent University (each 2%), and the universities Durham, Northumbria, Cranfield, University of West England, Birkbeck, Warwick, and Plymouth (each 1.3%). The remaining responses generated one response from each university.

The following sections provide survey responses by question, accounting for the dependent variable, and then broken down by factors explored in the study: availability and preference, wages, the War in Ukraine, evidence of arms exports to human-rights abusing regimes, approach from military/civilian recruiters, and support for national budgetary policies to expand civilian employment. Spaces that are left blank received no responses, and values are presented with percentages. A total of 155 students responded to the survey across a total of 44 UK universities. 7 responses originated from non-STEM departments and were hence removed from the survey. Therefore, a total of 148 survey responses were analysed.



Results

5.1 Dependent Variable

The dependent variable measures the extent to which STEM students would do military work, which is defined as "work for defence firms, military-serving laboratories, or

activities which directly promote military research, innovation, or production". This definition was provided on the questionnaire form, prior to the outline of questions, to inform respondents of how "military work" was conceptualised and defined for this study.

Table 1. Would you work for defence firms, military-serving laboratories, or engage in activities which directly promoted military research, innovation, or production i.e. military work?

Responses	Total Count
Definitely	32%
Maybe	27%
No	41%
Unsure, prefer not to say	0%

As shown by the responses, a large minority of STEM students in the sample would not do military work. The second-largest share of students would definitely do military work while the rest would maybe do military work. There was however no large and clear majority who would or not do military work. As stated in the previous chapter, the respondents were subdivided into three groups for further analysis: those who would definitely do military work (DEFINITELY), maybe do military work (MAYBE), or not do military work (NO). Prior to presenting results for these three groups in the following sections, the total results for all respondents will also be presented in each section.

5.2 Availability and Preference

Table 1.2 Assuming military work and civilian work were equally available to you, which type of work would you prefer?

Responses	Total Count
Civilian Work	66%
Military Work	15%
No preference	18%
Unsure, prefer not to say	0.67%

Table 1.3

Responses	Would Definitely Do Military Work	Would Maybe Do Military Work	Would Not Do Military Work
Civilian Work	15%	73%	100%
Military Work	45%	5%	
No Preference	40%	20%	

Unsure, prefer not to say		2%	

All respondents in the NO group, intuitively, preferred civilian work, so it is only respondents in the MAYBE and DEFINITELY groups that can be meaningfully compared with each other. A majority of respondents in the MAYBE group preferred civilian work, and also accounted for the vast majority of responses that preferred civilian work besides the NO group. On the other hand, while most respondents in the DEFINITELY group preferred military work, this group was mostly roughly divided between those who held a preference for military work and those who held no particular preference. Only a minority of this group preferred civilian work. The results therefore show that a considerable number of the DEFINITELY group did not uniquely value military work, similar to the Barrow survey.

5.3 Unavailable Civilian Alternatives

As stated in the last section, this study also asked respondents who preferred civilian work if they would take military work if civilian options were unavailable, and this filter question was specifically addressed to these respondents given the more controversial ethics of the arms industry.

Table 1.4 If you preferred civilian work, would you take military work if you were neither able to find nor obtain civilian work?

Responses	Total Count
Definitely	32%
Maybe	30%
No	38%
Unsure, prefer not to say	

Table 1.5

Responses	Would Definitely Do Military Work	Would Maybe Do Military Work	Would Not Do Military Work
Definitely	100%	65%	8%
Maybe		35%	31%
No			61%
Unsure, prefer not to say			

Respondents in the DEFINITELY group were intuitively comfortable with taking military work if they were unable to find civilian alternatives. Additionally, the majority of respondents in the MAYBE group were definitely open to military work if they were unable to find civilian alternatives. While most of the respondents in the NO group would still not take

military work in these circumstances, relative to the following responses, the NO and MAYBE groups were most likely to definitely do military work if they could not find civilian alternatives.

5.4 Wages

The table below summarises responses to the filter question for students who expressed a preference for military work over civilian work.

Table 1.6 If you preferred military work, would you take civilian work if it paid more?

Responses	Total Count
Definitely	33%
Maybe	50%
No	17%
Unsure, prefer not to say	

Table 1.7

Responses	Would Definitely Do Military Work	Would Maybe Do Military Work	Would Not Do Military Work
Definitely	24%	100%	
Maybe	57%		
No	19%		
Unsure, prefer not to say			

Most of these respondents would “maybe” take such work, while the second largest category would “definitely” take such work. Therefore, only a minority of those who preferred military work were unmoved by the prospect of higher wages for civilian work. These results are mirrored in the group responses, which showed that a majority of those in the DEFINITELY group would maybe take civilian work if it paid more. Notably, the offer of higher wages for civilian work did not strongly alter the preferences of those who preferred military work and those in the DEFINITELY group, since most would only “maybe” consider civilian work in such circumstances. While all the respondents in the MAYBE group would take civilian work if it paid more wages, very few respondents in this group preferred military work to begin with.

The responses below summarise the responses to the similar, and second, filter question for respondents who preferred civilian work.

Table 1.8 If you preferred civilian work, would you take military work if military work paid more?

Responses	Total Count
Definitely	12%
Maybe	29%
No	59%
Unsure, prefer not to say	

Table 1.9

Responses	Would Definitely Do Military Work	Would Maybe Do Military Work	Would Not do Military Work
Definitely	57%	24%	2%
Maybe	29%	72%	8%
No	14%	4%	90%
Unsure, prefer not to say			

The majority of those who preferred civilian work were not drawn by the prospect of higher wages to military work. As the breakdown between the three groups illustrate however, there were considerable differences between the three groups concerning the impact of higher wages for military work. Most respondents in the DEFINITELY would take higher paying military work, while the overwhelming majority of the NO group would still not take such work even if it paid more. The MAYBE group fitted neatly in between these two groups, with the vast majority responding that they would "maybe" take military work if it paid more. Therefore, despite a majority of the MAYBE group preferring civilian work, a similar majority of the MAYBE group that preferred civilian work would also "maybe" do military work if it paid more.

5.5 War in Ukraine

Table 1.10 Has the war in Ukraine affected your preferences for military work?

Responses	Total Count
It has made me more willing to do military work	15%
It has made me less willing to do military work	12%
It has made no difference and not affected my preferences	68%
Unsure, prefer not to say	5%

The results show that the war in Ukraine did not affect preferences for military work among a majority of the respondents. Furthermore, the following responses were slightly

divided between those who were more willing and less willing to do military work.

Table 1.11

Responses	Would Definitely Do Military Work	Would Maybe Do Military Work	Would Not Do Military Work
More Willing	32%	10%	6%
Less Willing	2%	12.5%	20%
No Difference	66%	65%	71%
Unsure, prefer not to say		12.5%	3%

As shown above, all three groups were very similar in terms of the non-existent impact of the war on their preferences for military work. However, the more/less willing responses among the three groups showed a trend. The greater the willingness to do military work, the more the war in Ukraine increased the willingness to do such work. In other terms, far more in the DEFINITELY group had their preferences for military work strengthened by the war than those in the MAYBE and NO groups. In contrast, the less the willingness to do military work, the more the war in Ukraine reduced the willingness to do such work.

5.6 Evidence of Arms Exports to Human-Rights Abusing Regimes

Table 1.12 Would evidence of UK arms exports to regimes that abuse human rights affect your preferences for military work?

Responses	Total Count
It would make me more willing to do military work	1.35%
It would make me less willing to do military work	66%
It would make no difference and not affect my preferences	29%
Unsure, prefer not to say	3.38%

Evidence of arms exports to human rights-abusing regimes would reduce the willingness of the majority of respondents to do military work. However, as the results below illustrate, and similar to the question of Ukraine, this response was unevenly divided among the three groups.

Table 1.13

Responses	Would Definitely Do Military Work	Would Maybe Do Military Work	Would Not Do Military Work
More Willing	4%		
Less Willing	30%	77.5%	87%

No difference	55%	22.5%	13%
Unsure, prefer not to say	11%		

Unlike the previous question on Ukraine, there was no clear majority in common among all three groups to any given response. However, similar to the previous question, the responses showed a trend. The greater the willingness to do military work, the less impact that such exports had on the willingness to do such work. Notably, the largest share of responses in the DEFINITELY group was that such evidence would make no difference. This group also included the only respondents who were "unsure" of how their preferences would be affected by such arms exports. Despite this, many of the respondents in the group, 30%, still felt that such exports would reduce their willingness to do such work, but this was in stark contrast to the NO and MAYBE groups, in which the vast majority felt that such exports would reduce their willingness to do military work.

5.7 Approach from Military/Civilian Recruiters

Table 1.14 Have you been approached by a recruiter or other individual about doing military work?

Responses	Total Count
Yes	24%
No	69%
Prefer not to say	7%

Table 1.15

Responses	Would Definitely Do Military Work	Would Maybe Do Military Work	Would Not Do Military Work
Yes	34%	17%	21%
No	55%	79%	72%
Prefer not to say	11%	4%	7%

Table 1.16 Have you been approached by anyone to work in the civilian or green sector?

Responses	Total Count
Yes	42%
No	55%
Prefer not to say	3%

Table 1.17

Responses	Would Definitely Do Military Work	Would Maybe Do Military Work	Would Not Do Military Work
Yes	38%	35%	49%
No	59%	62.5%	47%
Prefer not to say	3%	2.5%	4%

The responses showed stark differences between the three groups concerning whether they had been approached for civilian or military work. Those in the DEFINITELY group were approached for military and civilian work at very similar rates. On the other hand, those in the MAYBE and NO groups were much more likely to have been approached by someone from the civilian or green sector than approached for military work. In addition, these two groups were also less likely to have been approached by someone to do military work than those in the DEFINITELY group. Also, all three groups were more likely to prefer not to say whether they had been approached for military work than civilian or green work.

5.8 Support for National Budgetary Policies to Expand Civilian Employment

Table 1.18 Would you favour national budgetary policies that would expand the civilian opportunities for persons like yourself to get a job?

Responses	Total Count
Definitely	62%
Maybe	30%
No	4%
Unsure, prefer not to say	4%

Table 1.19

Responses	Would Definitely Do Military Work	Would Maybe Do Military Work	Would Not Do Military Work
Definitely	42%	70%	70%
Maybe	47%	25%	23%
No	4%	2.5%	5%
Unsure, prefer not to say	7%	2.5%	2%

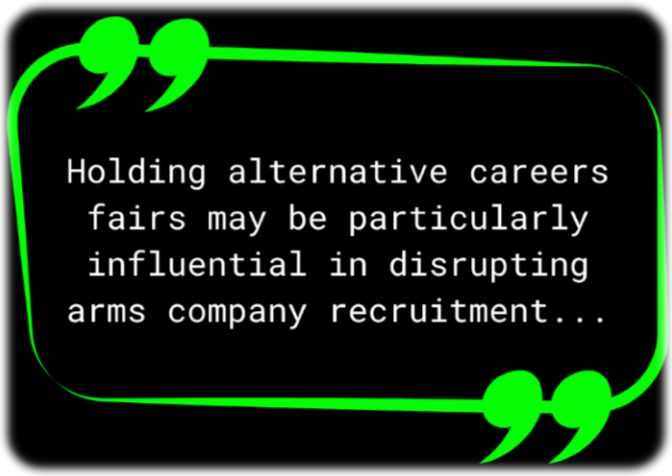
The stronger the willingness to do military work, the weaker the support for budgetary policies to increase the availability of civilian work. Those in the MAYBE and NO

groups held nearly equal preferences for such national budgetary policies to expand civilian employment, but respondents in the DEFINITELY group showed less support for such policies and were divided between “maybe” or “definitely” supporting such policies. However, despite 15% of the DEFINITELY group preferring civilian work, far more showed definitive support for these policies to expand civilian employment opportunities.

Discussion

While the limitations of this report means that these results cannot be generalised, some tentative conclusions and observations can be made. Firstly, these results illustrate the limitation of the BFBS survey not asking the 19% who would take STEM roles in the armed forces which type of work they prefer. As shown in this study, being willing to do or considering STEM roles in the military sector does not necessarily mean that one prefers such work to nonmilitary roles. In the case of the MAYBE group, despite considering military work, the group overwhelmingly preferred civilian work. Future research into career preferences in the military-industrial sector can hence derive greater nuance from interview subjects by asking those subjects to rank their preferred work roles.

On a different note, as previously described, arms companies often advertise careers through stalls in career fairs on university campuses. Actions against arms company stalls include “die-ins”, dismantling the stall, and holding alternative career fairs (Walton 2010:5), but results from this survey suggest that holding alternative careers fairs may be particularly influential in disrupting arms company recruitment, given that a lack of civilian alternatives exerted the most pressure on respondents in the NO and MAYBE groups to do military work, and that a significant percentage of those in the MAYBE group would rather do civilian work. Campaigners can utilise resources provided by organisations such as Scientists for Global Responsibility (SGR) to organise alternative careers fairs. SGR maintains a database of alternative career pathways for STEM professionals, such as electronics engineering for medical instruments, or geophysical expertise for environmental consultancy (Scientists for Global Responsibility n.d.).



On the other hand, the prospect of higher wages weakly altered the preferences of those who preferred military work, and such preferences were also mostly unaffected by evidence of arms exports to human-rights abusing regimes. In addition to this, unlike the NO and MAYBE groups, the war in Ukraine, besides mostly not affecting the preferences of the DEFINITELY group, still, if anything, increased the willingness of a notable proportion of this group to do military work. Similarly, those in the NO group had preferences that were also mostly unmoved by the prospect of higher wages for military work, as well as the war in Ukraine, but in stark contrast to the DEFINITELY group, a notable proportion of this group

had their preferences for military work weakened by the war in Ukraine. Taken together, these results showed that those in the DEFINITELY and NO groups had preferences that were mostly unaffected, or weakly affected, by most of the factors tested in this study (as stated previously, the absence of civilian alternatives however yielded the strongest effect on altering the preferences of those in the NO group). Also, the second most common response to the war in Ukraine in all three groups showed that the war polarised the different groups. Due to this, the study raises the possibility that, contrary to increasing the willingness to do military work, the war has instead had a polarising effect on STEM student preferences for military work, by, on the one hand, further convincing some STEM students to do military work, and, on the other hand, further dissuading some STEM students from military work.

Furthermore, while those who would not/maybe do military work had preferences that were the least affected by the war in Ukraine, these two groups had preferences that were the most affected by evidence of arms exports to human rights-abusing regimes. Conversely, respondents who would definitely do military work had preferences that were the most affected by the war in Ukraine but had preferences that were the least affected by evidence of arms exports to human rights-abusing regimes. These results from the DEFINITELY group are contemporarily significant since the arms industry is currently promoting itself as providing the “arsenal of democracy” for Ukraine despite continuing to arm authoritarian regimes. These results raise the possibility that this duplicitous self-presentation may not affect the willingness of many STEM graduates to work in the arms industry. Additionally, explaining the arms company’s destructive actions, which is another tactic that can be used to discourage students from working for an arms company (Walton 2010:4), may be relatively less effective at discouraging those who would do military work. However, the results also show that this tactic can be much more effective for those who would “maybe” do military work, while significantly further discouraging those who shun such work. Then again, as the results also showed, a high percentage of those in the MAYBE group, unlike the NO group, would “maybe” do military work if it paid more, so the MAYBE group’s ethical qualms with the arms industry may be more likely to be discarded by higher wages from military work.

On a separate note, the results showed that the extent to which STEM graduates are approached for civilian and military work can correlate with their willingness to do military work. The direction of these effects, however, are unclear. The BFBS survey showed that being exposed to STEM roles in the armed forces led to an increased willingness for STEM graduates to work in the armed forces, so in this sense, being exposed to STEM roles in the military-industrial sector can increase the willingness to do military work. However, those that are most willing to do military work may also be more likely to select situations in which they may be more likely to be approached for military work. For example, STEM graduates who would do military work may be more likely to seek out or attend open days hosted by the armed forces or arms companies, which are settings in which military work is more likely to be offered. Youth engagement teams from the MOD’s Defence STEM Engagement, and arms companies such as BAE Systems, organise open days to interact with STEM graduates (Ministry of Defence 2016, BAE Systems 2023). Future research can address such uncertainties.

The results showed a close overlap between preferences for military/civilian work and support for budgetary policies to increase civilian employment. Just as the DEFINITELY group was divided between those who preferred military work and those who held no special preference, so was this group roughly divided over support for policies to increase civilian employment. By extension, those in the MAYBE and NO groups much preferred civilian work as well as budgetary policies to expand civilian employment opportunities. Nevertheless, results from the DEFINITELY group are comparable to the Barrow survey, which showed that a much larger proportion of workers supported an expansion in civilian employment than preferred civilian work per se. Similarly, in this study, while only 15% of those in the DEFINITELY group preferred civilian employment, a much larger proportion supported an expansion in civilian employment opportunities. However, given the DEFINITELY group's relatively high preference for military work, then it is possible, as also shown in the Barrow survey, that this group supports a more "diversified" employment structure, in which more civilian occupations are made available without abandoning military occupations. On the other hand, the MAYBE and NO groups would be more likely to support conversion, due to their aversion or weak preferences for military work. Results from this study can hence be used as a basis for further investigations into student support for diversification and conversion.

6 - Future Research

This section provides avenues of future research utilising quantitative and qualitative interview methods. Due to the methodological limitations of this research, several of these approaches account for factors that were not addressed in the study but could be addressed in future research.

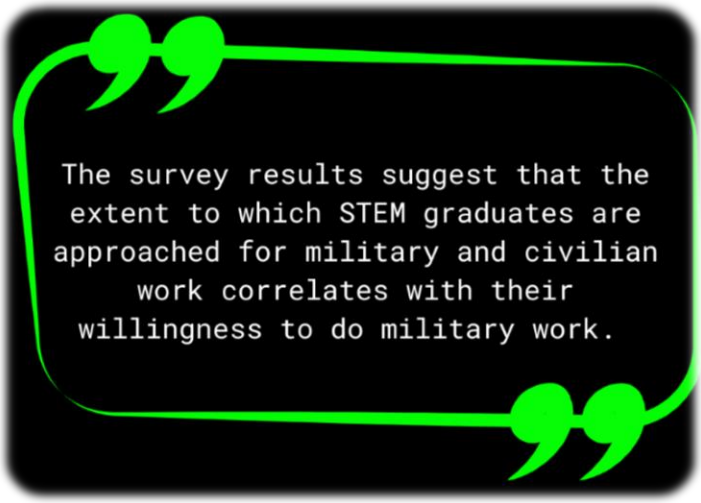
Future Survey Research

6.1 Geopolitical Crises

As previously shown, the war in Ukraine did not affect the majority of the respondents' willingness to do military work, but when it did, it was either in a positive or negative direction, depending on the initial disposition of the respondents towards military work. However, these findings may not necessarily indicate the limited impact of geopolitical events in shaping the willingness to do military work but may instead indicate the limited impact of the war in Ukraine in particular on shaping these preferences. Future studies can compare the relative influence of different geopolitical crises on the willingness to do military work. One current geopolitical crisis that may affect preferences for military work is the ongoing war in Gaza, escalating from October 2023. Students whose preferences are unaffected by the war in Ukraine may be otherwise affected by the war in Gaza, and vice versa. This study surveyed student's months before the war began, hence it could not be included as a factor in the study, but future studies can compare the impact of these geopolitical crises on preferences for military work.

6.2 Student Characteristics

Several characteristics of students may shape how they respond to queries of military work. Controlling for such factors and characteristics may hence generate certain patterns in survey results. Ethnic minority status is one such factor. The BFBS survey found that black STEM youth in particular were less likely to want to work in the armed forces (BFBS Creative 2021:4). The underrepresentation of ethnic minorities in this survey may therefore have potentially biassed the results in favour of a willingness to do military work. Future studies can employ sampling procedures to control for ethnic minority status in order to determine if such status can impact findings from surveys of military work. One of such factors from this survey that can be impacted by ethnic minority status is the extent to which STEM graduates are approached for civilian and military work.



The survey results suggest that the extent to which STEM graduates are approached for military and civilian work correlates with their willingness to do military work. However, ethnic minorities are underrepresented in the STEM workforce, and this has been linked to possible discrimination in the hiring process (Concept 2023). Due to this, STEM graduates from ethnic minority backgrounds may be less likely to be approached for civilian and/or military work in the STEM field, but it's unclear to what extent they are discriminated against in these fields. By controlling for ethnic minority status, future research can similarly investigate the extent to which such students have been approached for military and civilian work in comparison to white students, as well as the extent to which ethnic minority students would like to do military work. As the BFBS study found, being presented with STEM roles in the armed forces increased the willingness to do military work, and black STEM graduates were found to be less likely to have been aware of such roles (BFBS Creative 2021:4). However, even after being presented with such opportunities, black STEM graduates were still some of the least likely to want to do STEM work for the armed forces (ibid 2021:8). Therefore, even if ethnic minority candidates were approached at higher, equal, or lower rates to white STEM graduates, they may still have lower preferences for military work. Controlling for this factor and addressing the direction of effects concerning the relation between being approached for military work and being willing to do military work, can address these issues.

Beyond ethnic minority status, another element of student status that can impact responses to queries of military work is the STEM program the student is undertaking. As the Universum survey showed, engineering graduates mostly selected Lockheed Martin as their favoured employer, but such a result may be understandable given that the arms industry is disproportionately made of engineering professionals (Fraser et al 2017:8). A survey of engineers may hence be more likely to generate higher preferences for military

work than surveys of other STEM graduates. Additionally, some engineers may be even more likely than other engineers to do and prefer military work. Previous research in the U.S. showed that aeronautical engineering was more dependent on military contracts than other branches of science (Markusen 2001), so aerospace engineers may be likely to show particularly high preferences for military work, even relative to other kinds of engineers. Separately, computer science and mathematics professionals are being increasingly targeted by the military-industrial sector to develop AI (GlobalData n.d.). Given that this is linked to the changing nature of the arms industry, and its growing closeness to the civilian and commercial sector, inquiring into the preferences of computer and mathematics graduates for military work is highly relevant and topical. Future research can control for this factor through probability sampling, as previously mentioned. To account for this in research, the population, in this case STEM students in UK universities, can be sampled by stratifying their membership in specific STEM departments in universities, and following this, a simple random sample can be drawn from each strata (Bryman et al 2021:171). By sampling STEM students this way, researchers can investigate the extent to which STEM students in different STEM disciplines want to do military work, while also making distinctions between different branches of engineering.

6.3 Proximity to Arms-Manufacturing Sites

According to a report from the European Defence Agency (EDA), with RAND Europe and the Centre for the Study of Democracy, "the geographical location of defence industrial sites plays a role in people's awareness of the industry's presence and their consideration of the defence industry as a potential employer" (Freeman, Retter, Taggart 2015:6-7), so "physical proximity to a defence industry hub may, therefore, also shape the perception of defence, in both positive and negative ways" (ibid 2015:6-7). Additionally, as found by the BFBS survey, being made aware of STEM roles in the armed forces increased the willingness to work in the sector, so students who are close to arms-manufacturing sites may be more likely to be aware of STEM roles in the armed forces. Furthermore, as this study showed, there was a positive correlation between being approached for military work and wanting to do military work, so students in universities proximate to arms-manufacturing sites may also be more likely to be approached for military work. One avenue for this research is investigating universities in arms-dependent regions, such as the Southwest, in the UK. In 2020, MOD expenditure was shown to support jobs in the Southwest more than in any other region in the UK (Godding 2020), so universities located in the Southwest are particularly likely to be proximate to arms-manufacturing sites. However, as the EDA report also makes clear, such proximity can also raise the awareness of the industry among students who would be negatively disposed to work in the industry (Freeman, Retter, Taggart 2015:7). A university being proximate to an arms manufacturer may therefore have a polarising effect on student preferences to do military work.

The significance of conducting studies that account for this factor is shown by the results of this research. This study showed that the absence of civilian alternatives is the factor most likely to encourage students who wouldn't do military work to take on such work. Therefore, absent available civilian opportunities, students who would not and/or maybe do military work may find themselves in a similar situation as several interviewees in the study funded by the British Academy: working in a sector they would preferably not be

working for and feeling morally burdened by such work. But it is in such arms-dependent regions in which pressure and opportunities for military work may be greatest, particularly given, as mentioned by the EDA report, that cooperation between the arms industry and education sector, often for work opportunities such as work placements, apprenticeships, and internships, frequently occurs on a local level (ibid 2015:7). If similar majorities of students in such regions support national-level budgetary policies to expand civilian employment, are averse to military work, and prefer civilian work, even despite the offer of higher pay for military work, then this can generate powerful momentum for university support for economic conversion at the local, regional, and industry level. Previous attempts at conversion at the regional and industry level have faltered due to the lack of budgetary policies at the national level to support such policies (Bischak 1997, Casagrande 2001:149). Support among students for such policies can hence provide a strong political stimulus for conversion from universities.

6.4 Future Interview Research

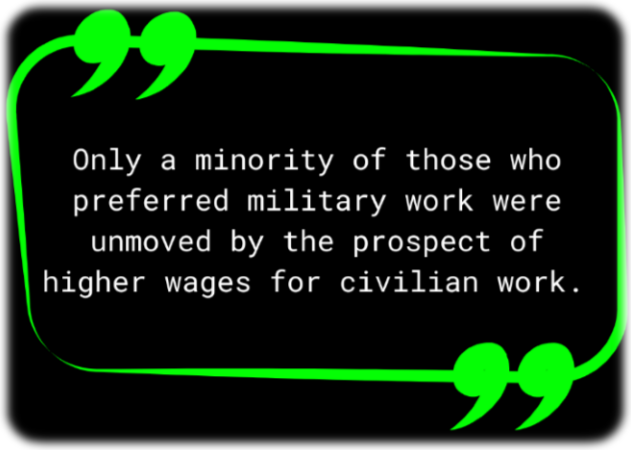
This research investigated the influence of external factors, particularly material, geopolitical, and ethical factors, on preferences for military work. This study hence "imposed" factors that were deemed relevant in shaping these preferences on the study participants. However, participants may have had their own reasons for definitely, maybe, or not wanting to do military work that were not covered by the factors given in the questionnaire. This is a limitation of survey methodology that adopts a quantitative approach with closed questions. Ordinarily, this limitation can be overcome through open-ended questions (Bryman et al 2021:235), but a focus group method can also surpass these limitations. Focus group discussions are interviews that are carried out with more than one interviewee, but unlike group interviews, focus group discussions are organised around a specific topic or theme (ibid 2021:453). Focus groups are adopted as methods in order to uncover why people feel the way they do about the particular topic, and also offer the opportunity for interviewees to probe each other's reasons for holding their respective views, and the free rein given to participants in a focus group permits them to raise issues related to a topic that they feel are significant (ibid 2021:454-455). Such issues can include factors that were not covered by this study. This method can offer the opportunity for students to raise factors that they feel affect their preference for military work that were not only not covered in this research, but in previous research. A focus group method can therefore make university students play an even more active role in these discussions.

7 - Conclusion

This study sought to determine the extent to which STEM students would do military work, the influence of various factors, including material and ethical ones, on such preferences for military work, and the degree of support for national budgetary policies to expand civilian employment. This study occurred at a time that the military-industrial sector is under significant pressure to boost recruitment of STEM professionals amidst an increase

in military budgets following the war in Ukraine, yet such pressure is also augmented by a perceived, and debatable, shortage of STEM professionals in the wider economy.

The respondents were roughly divided over a willingness to do military work, with a large minority being against military work, but the vast majority of respondents ultimately preferred civilian work, assuming such work was equally available to them. However, most of the responses also showed that the impact of the various factors on military work often depended on the initial disposition of the respondents to military work. Hence, only a minority of those who would definitely do military work preferred civilian work, but the vast majority of those who would maybe do military work preferred civilian work. The impact of the war in Ukraine and arms exports also depended on the initial disposition of the respondents to military work. The greater the willingness to do military work, the more the war in Ukraine increased that preference, and the less the impact of evidence of arms exports to human-rights abusing regimes. The study also found a correlation between being approached for military/civilian work and preferences for both kinds of work. Those that were approached for military work at higher rates also showed the strongest preference for military work.



Respondents who would definitely do military work, and prefer military work, were fairly rigid in their preferences, with no clear majority having these preferences strongly weakened by higher-paying civilian work or arms exports to abusive regimes. While making a large minority of the overall responses, respondents who would not do military work were similarly largely unflinching in their preference. Therefore, the preferences of this group were mostly unaffected by the prospect of higher wages, the lack of civilian alternatives, and the war in Ukraine, but the lack of civilian alternatives was relatively much more likely to convince this group to take military work than any other factor. In addition to this, while those who would maybe do military work overwhelmingly preferred civilian work, a majority of these respondents would also “definitely” take military work if they were unable to find civilian alternatives. These results show the importance of generating and advertising civilian alternatives, as well as budgetary policies at the national level to expand civilian employment, which was shown to have majority support from students who would not do and maybe do military work.

Despite the perceived urgency to increase recruitment into the military-industrial sector following the war in Ukraine, this study showed that this sample of respondents have not been similarly galvanised by the war to do military work. If anything, the study raises the possibility that, contrary to satisfying the need of the military-industrial sector to urgently boost recruitment, or expand the scope of the arms industry, many, if not most students, would rather that more civilian employment opportunities be made available. This speaks to the broader democratic deficit that results from universities orienting themselves to the needs and interests of “clients” such as the military and arms industry and not the needs

and interests of university students. This deficit is all the more serious at a time that the military sector is expanding into the civilian domain for development of future weapons technologies and other military technology. In light of these results and developments, and to alleviate this deficit, students ought to be far more strongly represented in these discussions and debates, as well as research, of recruitment into military careers.

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