Enhancing Interoperability Team Training: Insights from the UK Emergency Services

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RUNNING TITLE: Enhancing Interoperability Team Training

Abstract

Purpose: Interoperability is a core goal of the UK Emergency Services. The goal of this research was to survey the experiences of UK emergency responders who had undertaken interoperability training to evaluate its effectiveness. **Design:** We used a mixed-methods online survey methodology to evaluate training. **Findings:** Quantitively, we found participants rated live exercises and in-person training as the most useful. E-learning was the only training type that no participants rated as extremely useful, perceived as slightly useful. Qualitatively, participants described five requirements for good interoperability training, including: (i) representative and realistic; (ii) focused on sharing perspectives and developing awareness of capabilities and challenges across teams; (iii) prioritised as a core part of the day-job; (iv) face to face rather than remote; and (v) a platform for building social relationships. **Originality:** Future interoperability training must be regular, interactive, practical, and social, to improve multi-agency working.

Key words: Team training; interoperability; teamwork; extreme teams; emergency teams; team building

Introduction

A team is defined as "two or more individuals with specified roles interacting adaptively, interdependently, and dynamically toward a common and valued goal" (Salas *et al.*, 2005, p. 562). Teams enable individuals to combine their knowledge, skills, and expertise to achieve outcomes that go beyond the capabilities of a single team member. According to Hackman (1987) team inputs (e.g., personality) feed into team processes (e.g., communication), which feed into team outputs (e.g., goal accomplishment). Team processes are of central importance to understanding what makes an effective team. Research has found that team processes are adaptable, and that each episode of teamwork can feed into future episodes (Marks *et al.*, 2001; Oldeweme *et al.*, 2023). These episodes create "emergent states", which reflect the attitudes, beliefs, and feelings between team members (Salas *et al.*, 2015). For example, it has been found that cohesion, defined as the state of commitment or attraction between team members, is important for predicting team performance, which then feeds back in to informing future team cohesion, suggesting a reciprocal relationship (Braun et al., 2020). Identifying what these team processes and emergent states are and, importantly, how they interact to influence team performance is a key goal for team researchers.

What is team training?

Team training refers to the activities that are undertaken to build team-level knowledge, skills, and attitudes (Linhardt *et al.*, 2024). Team training can encompass a range of topics, including communication, coordination, goal setting, adaptivity, leadership and diversity (e.g., Davis et al., 2021; Gorman *et al.*, 2025). Yet, despite intense investment in team training, it has been highlighted that training does reliably improve performance (Warner,

2017). This has been linked to a lack of consideration of context when designing and delivering training and the relevance training has to the day-to-day activities of team members (Brown *et al*., 2020; Warner, 2017). For teams who operate in extreme environments, such as emergency teams, contextual sensitivity of training becomes particularly important as teams must be prepared to face unique challenges and pressures (Power, 2018). Schmutz *et al*. (2023) developed a team extremeness framework, whereby they conceptualise extreme teamwork as a continuous, multidimensional construct related to environmental extremeness and task extremeness. For example, a hospital team working within a hospital setting will have low environmental extremeness with high task extremeness but place them into a warzone and extremeness becomes high along both dimensions. The need for training to be contextualised to support teams operating within the extremeness continuum is essential. For example, Landon *et al*. (2018) highlighted that astronaut training must be designed to support small teams operating in isolation and close confinement, preparing them for multi-year future Mars missions. If team training lacks contextual sensitivity, it does not prepare team members to perform under the exceptional conditions they will face.

How to design team training to support emergency teamwork?

The goal of this research is to evaluate the effectiveness of team training provided to the UK Emergency Services. Emergency teams are extreme as they operate in environments that are dynamic, high-stakes and fast paced, and engage in complex and specialist task work (Power, 2018). Emergencies include major disasters, such as climate disasters and terror attacks, alongside “routine” emergencies such as road traffic collisions.

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In 2012, the Joint Emergency Service Interoperability Programme (JESIP) was launched with the goal to improve Emergency Services teamwork across the UK. JESIP training largely focused on the *taskwork* of interoperability, educating responders on the JESIP principles (e.g., need to co-locate), the METHANE acronym that is used to structure communications around key messages (e.g., is it a Major incident? What is the Exact location?) and the Joint Decision Model (JDM) - a shared decision model used to structure joint decision-making (JESIP, 2023). Initial training involved over 10,000 commanders, 22,000 personnel and 24 validation exercises (Skills for Justice, 2014), involving a mixture of formats including presentations, e-learning packages, and commander courses (HMIC, 2016). However, despite a shared goal to promote greater teamwork, assurance evaluations have highlighted variation in knowledge and understanding across emergency service groups and command levels (Skills for Justice, 2014; HMIC, 2016).

After the initial two-year rollout of JESIP, government resourcing and budget was significantly reduced (HMIC, 2016) to normalise interoperability, assuming interoperable teamwork would now be common practice. However, this strategy is at odds with the robust literature on teamwork training showing the need for ongoing assurance and adaptation. Bisbey *et al*. (2019) identified five pillars to effective teamwork training. These included: (i) ensuring a need for teamwork training; (ii) creating a positive teamwork training climate; (iii) maximising accessibility, usability, and learnability; (iv) evaluating training; and (v) creating a system to sustain training over time. The approach of JESIP mapped well to the first two pillars as interoperability training was both needed and desired, however the implementation of JESIP in practice has struggled with accessibility, evaluation and sustainability (Power et al., 2025). Accessibility was limited because JESIP training primarily targeted commanders in the Police, Fire, and Ambulance services,

excluding other critical emergency team members (e.g., operational staff, environment agency). Evaluation was hindered by the lack of a clear framework to define and measure "good" interoperability. Sustainability suffered from a short-term investment approach, with JESIP treated as "business as usual" after a two-year investment. Taken together, while JESIP aligns with the initial pillars of effective teamwork training - being both necessary and well-received - it falls short in addressing accessibility, evaluation, and long-term sustainability.

The goal of this paper was to evaluate existing interoperability training delivered to UK emergency responders. We adopted a mixed-methods survey design to gather objective ratings of the perceived usefulness of different types of interoperability training, in addition to rich qualitative insights via open-text boxes to evaluate perceptions. There were two main goals: (i) to evaluate perceived usefulness of existing interoperability training; and (ii) to generate best practice guidelines to help inform the design of future training.

Methodology

Participants

Participants were recruited online using professional social media and mailing lists, between September and December 2023. We collected data online to ensure a broad distribution of responses across the UK. 914 responses were recorded. 842 were excluded for either being a bot (fraudulent) response (n = 767), incomplete (n = 74), or from a non-UK responder (n = 1) (*see* Betts *et al*., 2024 for a discussion on the threat of bots in online research). This resulted in a final sample of 72 participants for inclusion, from the Ambulance Service (n=29), Fire and Rescue Service (n=21), Police Service (n=9), and other Emergency Services including local authorities and emergency preparedness organisations

(n=13). This sample was deemed sufficient due to the descriptive approach to quantitative data analysis and as this size provided a robust sample for analysing qualitative data. 26 participants were in a non-command role and 46 participants worked across command levels, including operational (n = 16), tactical (n = 20), and strategic (n= 10)[1], whose experiences of training varied. Length of service ranged from 1 to 42 years, with a mean average of 17 years (*SD* = 9.71). 57 respondents were male, 14 were female, and one participant did not disclose. Most participants were 45-54 years old (n = 28), followed by 35-44 years (n = 26), 25-34 years (n = 9), 55-64 years (n = 7), and 18-24 years old (n = 2).

Data Collection

We took a mixed methods approach to data collection, including closed and open questions in the online survey. There were three sections:

Experiences of Multi-Agency Training

We asked participants about their experiences of multi-agency training via three items: (i) when they had last taken part in multi-agency training; (ii) which training types (e-learning, tabletop exercises, small-scale live multi-agency exercises, large-scale live multi-agency exercises, workshops and in-person teaching) they had experienced (yes/no); and (iii) to rate their usefulness for improving interoperability, from 1 (extremely useless) to 7 (extremely useful).

[1] *Note: operational commanders are located at the scene of an emergency and are responsible for commanding the scene; tactical commanders are located at scene or remotely and are responsible for coordinating tactics; and strategic commanders are usually located remotely and responsible for strategizing the ongoing and future impact of an emergency.*

Experiences of JESIP

We asked participants about their experiences of JESIP training via three items, including: (i) whether they were aware of JESIP (yes/no); (ii) how they would rate their awareness of JESIP, from 1 (terrible) to 5 (excellent); and (iii) whether they had taken part in any formal JESIP training (yes/no).

Qualitative reflections on multi-agency training

We asked participants four open-text questions to draw qualitative insights from their experiences of interoperability team training. Participants were asked: (i) which aspects of multi-agency training had they found to be most useful for improving interoperability; (ii) which aspects of multi-agency training had they found to be least useful for improving interoperability; (iii) how would they improve interoperability training; and (iv) any final comments or reflections about interoperability training.

Data Analysis

Quantitative responses were analysed using R statistical software to calculate descriptive statistics for each variable, including frequencies, proportions, averages, and standard deviations. Qualitative data from the four open-text questions were combined for each participant and thematically analysed, using an inductive, reflective thematic analysis approach (Braun & Clarke, 2019) by a single member of the research team to identify initial themes. Following the identification of initial themes, the research team met as a group to reflect upon and refine themes into a codebook (*see* Byrne, 2022), and two coders coded the data. This codebook style approach was suitable for our data as each participant was provided the same open-text question and so we coded participants for their self-reported

themes. Across the dataset, there was a disagreement rate of 12.27% between coders, which were discussed and coded to consensus.

Results

Experiences of Multi-Agency Training

Participation in training

Out of 72 participants, 5 had not taken part in any multi-agency training. Of those who had, most had done so within the last 3 months (58%), followed by within the last 6 months (15%); longer than 2 years ago (12%); within the last 12 months (7%); and within the last 2 years (4%).

Types of training

Participants took part in a range of multi-agency training events in different formats. E-learning was the most common (79%), followed by both large- (69%) and small-scale (69%) live multi-agency training, tabletop exercises (67%), in-person teaching (60%) and workshops (45%).

Usefulness of training.

Perceived usefulness of training was positive across training types, with a median of 6.5 (moderately useful to extremely useful). The three most popular types of training were small-scale live exercises (*Md*= 7, *SD*=1.11), in-person teaching (*Md*=7, SD=1.26), and large-scale live exercises (*Md*=7, *SD*=1.48), where over 50% of participants who had engaged with this training found it extremely useful (Figure 1). Tabletops (Md=6, *SD*=1.27) and Workshops (*Md*=6, SD=1.21) were next most favourable. E-learning was the only type of training that

was not perceived as extremely useful by any participants, with a median score of 5 (SD=1.58), suggesting it was perceived as slightly useful.

JESIP Awareness and Training

97% participants said that they were aware of JESIP. 83% said that they had taken part in JESIP training. Participants rated their awareness of JESIP between average and good (M = 3.92; *SD* = .93). Most participants had completed JESIP training in the last three months (32%), followed by in the last 6 months (23%), 12 months (20%), two years (17%) or over two years ago (8%).

Qualitative findings

Qualitative data was thematically analysed to identify core requirements for multi-agency training. We identified five main themes, reflecting the desire for multi-agency training to be: (i) representative and realistic; (ii) focused on sharing perspectives and developing awareness of capabilities and challenges across teams; (iii) prioritised as a core part of the day-job; (iv) face to face rather than remote; and (v) a platform for building social relationships.

Representative and realistic

76% of our sample described that effective interoperability team training needed to be representative and realistic to ensure that the agencies involved in real-world emergencies were also involved in training. Participants described that multi-agency training often lacked multi-agency input during design: “the event being used to base the training on was ‘solo agency’ focused (large fire for example) which has little impact to other agencies”

(P57)[2], reflecting frustration when attending training that was not designed with their agency in mind: “I feel that the ambulance service rarely get the full potential out of training exercises due to not having enough input into developing the exercise” (A34). Representation was also lacking across command levels: “I think the focus needs to be more on the ground level. Middle management and above are familiar with JESIP principles. But ask the constable, paramedic or watch commander about JESIP and 80% won’t even have heard of it” (F52). Realism was also an issue with training, as participants described a tendency for training to focus on major incidents over routine interoperable emergencies: “make it more regular and don't continually provide huge exercises. Little and often is probably best rather than training against a once in lifetime type of incident.” (F70). Training also lacked realism when trainers sought to maximise training benefit by involving too many people: “more realistic training exercises. Less time to prepare, use of current people on duty rather than having the luxury of additional staff who have been brought in just to complete the exercise” (A38).

Positively, participants described training as effective when it was realistic: “Recently undertook a live exercise which allowed all involved to test training under pressure in a realistic environment” (A38). Participants recommended that all core Emergency Services be involved in the planning stage of training to maximise realism: “Make sure all 3 services have equal input into the training, and make sure all aims and objectives are met” (A36). Participants recommended that multi-agency training should regularly include Category 2 responders (e.g., utility and transport companies) to support representation and realism: “While the training is helpful from a blue light agency perspective, it seldom involves cat 2

[2] Participants from the Police are coded P; from Fire as F; from Ambulance as A; and other agencies as O.

responders. It is these agencies who have skills and resources that are vital to successfully concluding any major incident" (F48).

Sharing perspectives and developing awareness of capabilities and challenges across teams.

65% of participants described how interacting with other services during multi-agency training enabled them to build knowledge about inter-agency capabilities and the role-specific challenges faced by different agencies. Training aided decision-making by bringing together diverse viewpoints: "Multi-agency training brings different views to one situation, when dealing with an incident having a broad knowledge of all responders helps make clear and consistent decisions" (O25). Participants learnt about the skills and capabilities of multi-agency colleagues during training, which gave them confidence to work together in the real-world: "I also found that gaining insight into other services' capabilities gave me a much more confident understanding of how best to use them practically" (A27). Training built empathy and understanding about role-specific challenges: "I gained a greater understanding of the other services ways of working and their priorities during the specific type of major incident being exercised. I also gained an insight into the challenges they face at that type of incident" (A34). Taken together, multi-agency training was perceived as useful when it provided a safe space to develop shared awareness and understanding across teams.

Multi-agency training should be prioritised as part of the day-job

64% of the sample described the need for multi-agency training to be a core part of the day-job for emergency responders. Participants expressed that multi-agency training should not be an optional add-on to their operational duties:

> I would like to see training, including multi-agency training, to be well established and prioritised at my agency. It is essential staff have up to date training within their role, and know their agency's role, in order to get the most out of multi-agency training and indeed be effective in multi-agency practice in the real world. Furthermore, I firmly believe this needs to permeate all levels of operational staff. (A67)

Linked to our earlier theme on representation, participants described how the opportunity to engage with multi-agency training was disproportionate and not prioritised for staff groups who were operationally busy:

> The key obstacles are around the service continually 'running hot'. This often means we don't have the opportunity to properly reflect on events or training. Additionally, it means that specialist responders are disproportionately exposed to joint training but 'business as usual' staff rarely get the same level of opportunity." (A56).

When asked how to improve interoperability training 33% recommended increasing frequency. One participant highlighted "having more of the same [training] to be honest" (P47), while another sought "to actually receive some" (F66) training. Participants described how emergency response organisations should prioritise multi-agency training for all staff: "it should be mandatory for all operational staff, not just commanders. Whilst these exercises are undoubtedly expensive and logistically challenging, these barriers should not be prohibitive" (A45), but that this required central buy-in and financing: "prioritise and promote joint training sessions - requires significant buy in in terms of time and money" (A28).

The need for face-to-face training.

40% of our sample described the need to have more face-to-face interaction during training: “we need to move above and beyond just basic classroom training and actually exercise/work better together” (F18). Face-to-face training was perceived as useful to build understanding about applying JESIP principles: “Live exercises are the best form of training for embedding JESIP” (O59) and how to effectively communicate with team members: “multi-agency training can help firefighters learn how to effectively communicate and coordinate with personnel from other agencies during an emergency” (F22). Participants acknowledged that whilst e-learning can be useful it cannot replicate in-person training: “E-learning packages can be useful, as a pre-read prior to attending a face-to-face course, but should not be a substitute for in person training” (O59). Succinctly, one participant responded: “more live training sessions, less PowerPoint” (P72).

A platform for building social relationships

33% of participants described how multi-agency training was most useful when there was time to build new relationships and connections with other emergency team members: “the chance to network with colleagues in ‘peacetime’ so that meeting during an incident is not a shock” (O23). Networking with others was deemed to be important for establishing familiarity prior to attending an incident: “getting to know other commanders on a personal level - so when it comes to an incident it is a case of 'How are you?', not 'Who are you?'” (F64). Participants described the need to establish relationships at a local level so that they are more likely to know each other when attending an incident: “more regular [training] and try where possible to keep to localities. So, you're more likely training with people you may see on incidents” (F55). It was noted that that relationship building could be developed during coffee or lunch breaks, suggesting that building time into training for social

interaction is key: “getting to know commanders by name, having shared experiences or coffee” (A10).

Discussion

This study evaluated the perceived effectiveness of Emergency Services interoperability training in the UK. The research is grounded in the understanding that teams are crucial for achieving goals in complex task environments (Schmutz *et al*., 2023), and that team training is essential for enhancing team performance through improved skills, shared sense making and knowledge (Salas *et al*., 2007). This study employed a mixed-methods approach to assess the perceived usefulness of current training offerings, yielding several insights. Results showed that interactive and in-person training was perceived as the most useful training type by emergency responders. E-learning was the only training type that no participants rated as extremely useful, with the lowest median rating of slightly useful. Qualitatively, we identified five themes that reflected the key requirements for future interoperability training to be: (i) representative and realistic; (ii) focused on sharing perspectives and developing awareness of capabilities and challenges across teams; (iii) prioritised as a core part of the day-job for emergency responders; (iv) face to face rather than remote; and (v) a platform for building social relationships.

The first part of our discussion will reflect on the perceived usefulness of different training formats. Generally, participants perceived all training types to be useful, with median scores ranging from extremely useful to somewhat useful. There was a strong preference for interactive and in-person training, as evidenced in our qualitative themes for “representative and realistic” and “face-to-face” training. In line with Bisbey *et al*.’s (2019) recommendation that team training should be accessible, usable, and learnable; we

recommend that future interoperability training involve social interaction between team members using scenario-based exercises that enable team members to put teamwork into practice. Further, we recommend that e-learning should be provided *in addition* to in-person training, but not be the focal method of delivery. This blended approach can address the need to provide training which is accessible and low-cost (Panigrahi *et al*., 2018) amid financial and capacity constraints across the UK Emergency Services.

There is very little literature available to identify whether e-learning works for training teams, especially those operating in extremes. It is unlikely that e-learning can capture the extremeness of both the environment and task, which are core features of emergency teams (Schmutz, *et al*., 2023). One loosely related study looked at the efficacy of e-learning for training physicians and nurses on how to provide advanced civilian and military trauma care (Sonesson *et al*., 2018). They found a limitation of e-learning was the lack of real practice, which was essential for learning, and that a lack of interaction with multidisciplinary colleagues meant trainees did not learn about roles and responsibilities and the broader team structure, which is known to be important for multi-team coordination in emergencies (Power, 2018; Power & Alison, 2017).

Sonneson *et al*. (2018) recommend that a blended approach to training, mixing e-learning with more traditional classroom methods, is a useful pedagogic model. Blended learning has been effective in various sectors. Ma and Lee (2021) found in higher education that blended learning was scored by higher by students on attention, confidence and satisfaction in comparison to purely online learning, and that it was scored higher on satisfaction compared to face-to-face learning. Higher satisfaction rates were related to perceptions that blended learning provided flexibility for accessing materials whilst

maintaining opportunities to interact with peers. In the military, Retter *et al*. (2024) identified similar advantages to blended learning – including flexible and tailored learning – but also disadvantages related to reliance on technology. They recommended that a mixture of in-person residential training alongside asynchronous online learning was most appropriate, which reflects the structure of current training delivered by the US Army War College (Martin, 2023). Taken together, we recommend a blended approach to support interoperability training. This approach affords the benefits of e-learning, such as accessibility and affordability, which are of practical importance to the emergency services, whilst offering the important benefits of in-person interaction and building social bonds. However, it is important that careful consideration be paid to balancing a blended learning approach, ensuring that dual benefits are maximised.

Our qualitative data revealed a desire from participants for interoperability training to build a shared sense of togetherness. Participants described good interoperability training as training that supported the sharing of inter-team perspectives, building awareness of capabilities and agency-specific challenges, alongside interpersonal relationships. Research by Power *et al*. (2024; 2025) highlighted how interoperability is not just about the structural network of the team (e.g., communication protocols) but that social-psychological components, including social identities, trust, and goals, are essential for interoperability. The importance of social-psychological connection is further supported by West and Lyubovnikova (2012) in their distinction between real teams (psychologically connected team members) and pseudo-teams (disconnected team members who share a space). Davidson *et al*. (2022) found that shared identities in emergency teams were important, emphasising how pre-existing relationships and a sense of "common fate" could support interoperability. We recommend that social learning – linked to relationship

building, camaraderie and connection - should be a core learning objective for interoperability training. This could be achieved through having dedicated time for responders to share lived experiences during training, developing a sense of "common fate" and shared identity (Davidson *et al.*, 2022).

A final finding from our research was the desire by participants to make interoperability training part of the day job of emergency responding. This aligns with the findings of Power *et al*. (2025) that systemic issues related to a lack of operational capacity to engage in training have widened the principle-implementation gap for interoperability as interoperability training is not prioritised. It is difficult to identify a precise number of times that a team should be trained to fully embed interoperability. Bredin *et al*. (2022) evaluated the frequency of trauma team training in Norwegian hospitals and found a significant positive association between training frequency and team competence, with no evidence of training fatigue. Landon *et al*. (2018) highlighted the need for regular training for astronaut teams due to the potential time lag experienced between training and application in long duration space missions. Thus, team training is insufficient if not provided with some level of regularity. Currently, commanders must engage in JESIP training once every three years (JESIP, 2023). However, to develop and maintain interoperability skills, the Emergency Services must be mandated to engage in regular (at least yearly) joint training. Annual multi-agency training has also been recommended in Australia (NSW Government, 2020).

Our research findings have international applicability to other emergency management organisations. Like in the UK, countries such as the US and Australia operate a decentralized, bottom-up approach to emergency management (Alteneiji *et al*., 2021), necessitating the need for interoperability training. Although JESIP training has been

conducted in Gibraltar (HM Government of Gibraltar, 2022), its use in other countries is limited. Instead, counties have developed their own interoperability frameworks, including the National Interagency Incident Management System in the US and the Australasian Inter-Service Incident Management System in Australia and New Zealand (Holley & McArthur, 2022). Research to map and compare these different interoperability systems would be useful to developing best practice guidelines.

Limitations

A limitation to our study is that the unequal sample size did not allow for cross-service comparison on our measures. This was partly related to an issue with the online survey format, which resulted in erroneous bot responses that were removed during analyses after the survey had closed (*see* Betts *et al*., 2024). Although this was not an original goal of the research, it might have been useful to explore comparisons across sectors to build ideas for future research. Another limitation is that this study measured participants perceptions of the usefulness of team training rather than its impact on team performance. Future research could triangulate measure of team performance. For example, the Kirkpatrick (2016) model, designed to evaluate training, could be used to structure evaluations of training along measures of trainee satisfaction; acquired skills and knowledge; application of skills and knowledge; and whether the intended outcomes of training occur. By triangulating measures of team training along measures such as this, a more robust understanding of team training at both individual, team-level and organisational levels can be established. A final limitation of our research is that we are aware our findings highlight an "ideal" model of interoperability training, but that there often exists a gap between idealised principles and challenges related to implementation

(Power et al., 2025), such as financial and capacity constraints in the public sector. Despite this, we argue that it is important to outline best practice models to provide a clear direction for the future, and that our findings can be used to lobby for greater investment in emergency interoperability training.

Conclusion

Our research assessed the perceived usefulness of UK interoperability training and proposed best practice solutions. We found that team training must be interactive and in-person to support emergency interoperability. Whilst live exercises and in-person training were perceived as most useful, e-learning was perceived to be the least useful, indicating a preference for methods involving face-to-face interaction and scenario-based exercises. Our qualitative findings highlighted that interoperability training that is perceived as useful must be: (i) representative and realistic; (ii) focused on sharing perspectives and developing awareness of capabilities and challenges across teams; (iii) prioritised as a core part of the day-job; (iv) face-to-face; and (v) provide a platform for building social relationships. Thus, interoperability training must be regular, interactive, and in-person, incorporating social learning about team members as a learning objective. This will help build social-psychologically connected teams, enhancing interoperability.

References

Alteneiji, H. R., Ahmed, V., & Saboor, S. (2021). A Strategic Approach to Emergency Preparedness in the UAE. In S. M. Ahmed, P. Hampton, S. Azhar, & A. D. Saul (Eds.), *Collaboration and Integration in Construction, Engineering, Management and Technology* (pp. 241–246). Springer International Publishing. https://doi.org/10.1007/978-3-030-48465-1_40

Besser, A., Flett, G. L., & Zeigler-Hill, V. (2022). Adaptability to a sudden transition to online learning during the COVID-19 pandemic: Understanding the challenges for students. *Scholarship of Teaching and Learning in Psychology*, 8(2), 85–105. https://doi.org/10.1037/stl0000198

Betts, C., Power, N. and Lynott, D. (2024), "How we learnt to battle the bots", *The British Psychological Society*, 23 January, available at:

Bisbey, T.M., Reyes, D.L., Traylor, A.M. and Salas, E. (2019), "Teams of psychologists helping teams: The evolution of the science of team training.", *American Psychologist*, American Psychological Association (APA), Vol. 74 No. 3, pp. 278–289, doi: 10.1037/amp0000419.

Braun, M. T., Kozlowski, S. W. J., Brown, T. A. (Rench), & DeShon, R. P. (2020). Exploring the Dynamic Team Cohesion–Performance and Coordination–Performance Relationships of Newly Formed Teams. *Small Group Research*, 51(5), 551-580. https://doi.org/10.1177/1046496420907157

Braun, V. and Clarke, V. (2019), "Reflecting on reflexive thematic analysis", *Qualitative Research in Sport, Exercise and Health*, Informa UK Limited, Vol. 11 No. 4, pp. 589–597, doi: 10.1080/2159676x.2019.1628806.

Bredin, I.C., Gaup, H.M.J., Brattebø, G. and Wisborg, T. (2022), "Trauma team training in Norwegian hospitals: an observational study", *BMC Emergency Medicine*, England, Vol. 22 No. 1, pp. 119–119, doi: 10.1186/s12873-022-00683-9.

Brown, O., Power, N. and Conchie, S.M. (2020), "Immersive simulations with extreme teams", *Organizational Psychology Review*, SAGE Publications, Vol. 10 No. 3–4, pp. 115–135, doi: 10.1177/2041386620926037.

Byrne, D. (2021), "A worked example of Braun and Clarke's approach to reflexive thematic analysis", *Quality & Quantity*, Springer Science and Business Media LLC, Vol. 56 No. 3, pp. 1391–1412, doi: 10.1007/s11135-021-01182-y.

Cooke, N. J. (2015). Team Cognition as Interaction. *Current Directions in Psychological Science*, 24(6), 415–419. https://doi.org/10.1177/0963721415602474

Davis, A. S., Kafka, A. M., González-Morales, M. G., & Feitosa, J. (2022). Team belonging: Integrating teamwork and diversity training through emotions. *Small group research*, *53*(1), 88-127.

Davidson, L., Carter, H., Drury, J., Amlôt, R. and Haslam, S.A. (2022), Advancing a social identity perspective on interoperability in the emergency services: Evidence from the Pandemic Multi-Agency Response Teams during the UK COVID-19 response, *International Journal of Disaster Risk Reduction : IJDRR*, England, Vol. 77, pp. 103101–103101, doi: 10.1016/j.ijdrr.2022.103101.

Gorman, J. C., Grimm, D. A. P., Robinson, F. E., Winner, J. L., Wiese, C. W., & Roudebush, C. (2025). Dynamic Measures of Team Adaptation. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 00187208251314262. https://doi.org/10.1177/00187208251314262

Hackman, J.R. (1987), "The design of work teams", in Lorsch, J. (Ed.), *Handbook of Organizational Behavior*, Prentice-Hall, Englewood Cliffs, NJ.

HM Government of Gibraltar. (2022). *Joint Emergency Services Interoperability Principles (JESIP) training delivered in Gibraltar*. https://www.gibraltar.gov.gi/press-releases/joint-emergency-services-interoperability-principles-jesip-training-delivered-in-gibraltar-7442022-8329

HMIC. (2016), "The tri-service review of the Joint Emergency Services Interoperability Principles", *His Majesty's Inspectorate of Constabulary and Fire & Rescue Services*, available at: https://hmicfrs.justiceinspectorates.gov.uk/publications/the-tri-service-review-of-the-joint-emergency-services-interoperability-principles/

Holley, A., & McArthur, T. (2022). PPRR and AIIMS: A whole-of-government strategy in NSW. *Australian Journal of Emergency Management*, 10.47389/37(No 3), 65–74. https://doi.org/10.47389/37.3.65

JESIP (2023). JESIP Training and Awareness. https://www.jesip.org.uk/news/jesip-training-and-awareness-2/

Kirkpatrick, J. D., & Kirkpatrick, W. K. (2016). Kirkpatrick's four levels of training evaluation. Association for Talent Development.

Landon, L.B., Slack, K.J. and Barrett, J.D. (2018), "Teamwork and collaboration in long-duration space missions: Going to extremes.", *American Psychologist*, American Psychological Association (APA), Vol. 73 No. 4, pp. 563–575, doi: 10.1037/amp0000260.

Linhardt, R. M., Bisbey, T. M., & Salas, E. (2024). The science and practice of team training: Historical progress and a research agenda. *Consulting Psychology Journal, 76*(1), 70–92. https://doi.org/10.1037/cpb0000263

Ma, L., & Lee, C. S. (2021). Evaluating the effectiveness of blended learning using the ARCS model. *Journal of Computer Assisted Learning*, 37(5), 1397–1408. https://doi.org/10.1111/jcal.12579

Marks, M.A., Mathieu, J.E. and Zaccaro, S.J. (2001), "A Temporally Based Framework and Taxonomy of Team Processes", *Academy of Management Review*, Academy of Management, Vol. 26 No. 3, pp. 356–376, doi: 10.5465/amr.2001.4845785.Martin, R. D. (2023). *Blended Education at the U.S. Army War College: Adapting to modern learning realities.* U.S. Army War College. https://www.armywarcollege.edu/News/Archives/14396.pdf

NSW Government. (2020). *NSW Bushfire Inquiry report.* https://www.nsw.gov.au/departments-and-agencies/premiers-department/access-to-information/nsw-bushfire-inquiry/nsw-bushfire-inquiry-report

Oldeweme, M., Konradt, U., & Brede, M. (2023). The rhythm of teamwork: Discovering a complex temporal pattern of team processes. *Group Dynamics: Theory, Research, and Practice*, 27(1), 50–64. https://doi.org/10.1037/gdn0000175

Panigrahi, R., Srivastava, P.R. and Sharma, D. (2018), "Online learning: Adoption, continuance, and learning outcome—A review of literature".

Power, N. (2018), "Extreme teams: Toward a greater understanding of multiagency teamwork during major emergencies and disasters.", *American Psychologist*, American Psychological Association (APA), Vol. 73 No. 4, pp. 478–490, doi: 10.1037/amp0000248.

Power, N., Alcock, J., Philpot, R. and Levine, M. (2023), "The psychology of interoperability: A systematic review of joint working between the UK emergency services", *Journal of Occupational and Organizational Psychology*, Wiley, Vol. 97 No. 1, pp. 233–252, doi: 10.1111/joop.12469.

Power, N., Philpot, R., Levine, M., & Alcock, J. (2025). Bridging the Principle-Implementation Gap: Evaluating organizational change to achieve interoperability between the UK Emergency Services. *Journal of Occupational and Organizational Psychology*, *98*(1), e70010. https://doi.org/10.1111/joop.70010

Retter, L., Eken, M., Palicka, O., & Davies, H. (2024). *Blended learning in joint professional military education*. RAND Corporation and King's College London. https://doi.org/10.7249/RRA3491-1

Salas, E., Nichols, D.R. and Driskell, J.E. (2007), "Testing Three Team Training Strategies in Intact Teams", *Small Group Research*, SAGE Publications, Vol. 38 No. 4, pp. 471–488, doi: 10.1177/1046496407304332.

Salas, E., Sims, D.E. and Burke, C.S. (2005), "Is there a 'Big Five' in Teamwork?", *Small Group Research*, SAGE Publications, Vol. 36 No. 5, pp. 555–599, doi: 10.1177/1046496405277134.

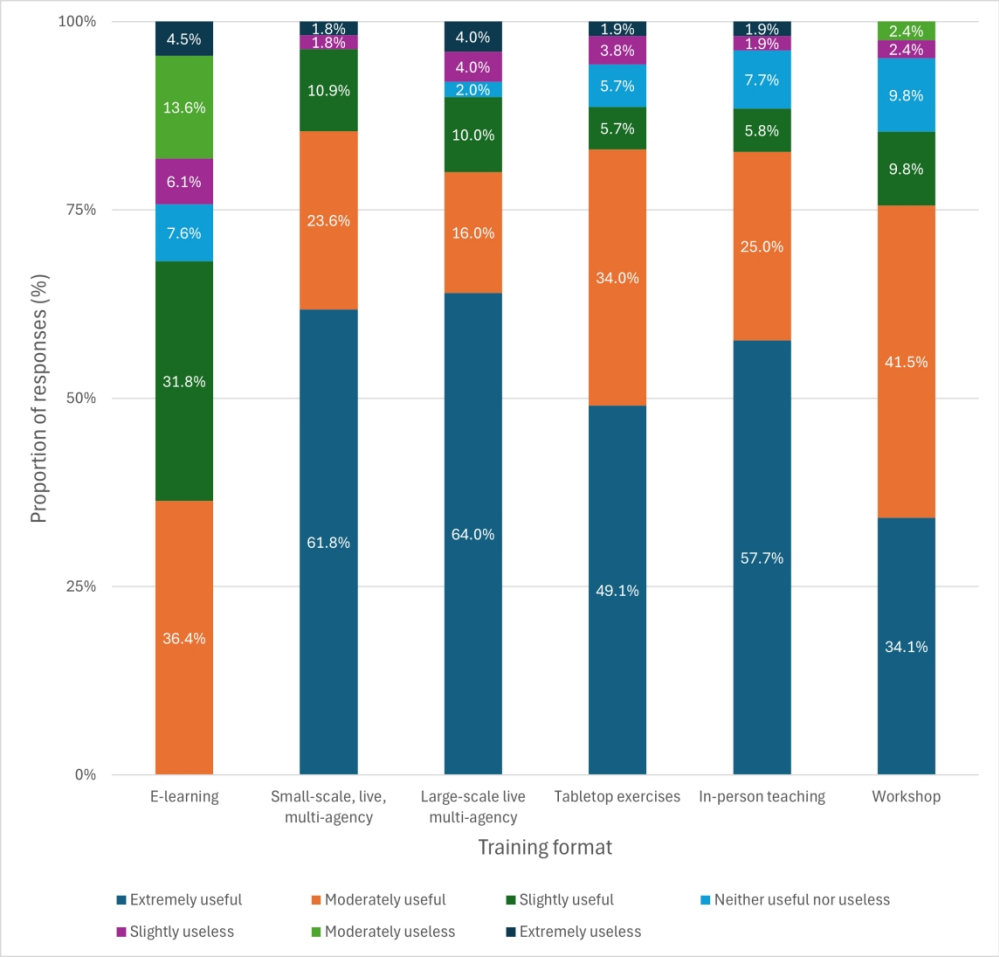
Schmutz, J.B., Bienefeld, N., Maynard, M.T. and Rico, R. (2023), "Exceeding the Ordinary: A Framework for Examining Teams Across the Extremeness Continuum and Its Impact on Future Research", *Group & Organization Management*, United States, Vol. 48 No. 2, pp. 581–628, doi: 10.1177/10596011221150756.

Skills for Justice (2014*) Emergency services interoperability research wave 2: report and recommendations*. Available at: https://www.jesip.org.uk/wp-content/uploads/2022/03/JESIP_Workforce_Survey_2_Full_.pdf

Sonesson, L., Boffard, K., Lundberg, L., Rydmark, M. and Karlgren, K. (2018), "The potential of blended learning in education and training for advanced civilian and military trauma care", *Injury*, Elsevier BV, Vol. 49 No. 1, pp. 93–96, doi: 10.1016/j.injury.2017.11.003.

Warner, T. (2017). Corporate learning programs need to consider context, not just skills. *Harvard Business Review Digital Articles*, 2-5.

West, M.A. and Lyubovnikova, J. (2012), "Real Teams or Pseudo Teams? The Changing Landscape Needs a Better Map", *Industrial and Organizational Psychology*, Cambridge University Press (CUP), Vol. 5 No. 1, pp. 25–28, doi: 10.1111/j.1754-9434.2011.01397.x.



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Reviewer 1	
This is a well written paper and has really important findings regarding the training of teams within the emergency services. I think there are a few areas where there might be areas for improvement ahead of publication.	Thank You
Firstly, on initial reading of the paper, the first few paragraphs had more "dated" literature, and it might be worthwhile exploring whether there is any more up-to-date literature, specifically around the definitions would be helpful, and just to re-assure the readers.	We have included more recent literature and in cases where citations are dated (but are key references), these have been retained. These changes are shown on Page 2 and 3. The new references include: Braun et al., 2020; Oldeweme et al., 2023; Davis et al., 2021; Gorman et al., 2025).
It could also be useful to discuss broader discussions within the literature around the shift to online learning through the pandemic within other sectors, such as higher education, as your findings show support for more classroom or practical learning, against online training. This would make the paper useful not just for emergency service, but perhaps for other sectors too.	Thank you for your comment. We have now added a discussion on the use of e-learning and blended learning within higher education (Ma and Lee, 2021) and the military (Sonneson et al., 2018) (p15-16).
I think a limitations section where you discuss the limitations of the methodology more thoroughly would be a useful addition	Thank you for your comment. A limitations section has now been included (p18-19).
Finally, I think you have strong implications to practice and further research, and it would be useful to make these a bit stronger, the conclusion section is great, but replicating this in the discussion section would be useful. Thank you for this paper, and I look forward to reading it when it is published.	Thank you for your comment and positive feedback. We have added to the discussion: recommendations for team training, international implications, and acknowledge the balance between what is perceived as "ideal" training versus what is practical and achievable within the UK Emergency Services.
1.Originality: The study focuses on a specific area within emergency services training: interoperability training for UK Emergency Services. It addresses a gap in the literature by directly evaluating the effectiveness of existing interoperability team training and generating best practice guidelines. The study provides empirical evidence supporting the effectiveness of certain training methods over others. Specifically, it highlights the preference of emergency responders for interactive and in-person training formats, such as small and large-scale exercises, over e-learning. This finding contributes to our understanding of effective training design in this context.	Thank You
2. Relationship to Literature: The paper demonstrates an adequate understanding of the relevant literature in the field and cites an	Thank you for your comment. We have included more recent literature (see above). We have chosen to retain some of the more

appropriate range of literature sources. The authors draw upon several key areas of research to contextualise their findings and recommendations, including Teamwork and Team Training, Extreme Teams, Interoperability in Emergency Services, different training methods, etc. However, it would be useful for the authors to include some more up-to-date references in the paper; for example, the first few paragraphs cite research from the early 1990's and 2000's, are there not more recent definitions of "teams" or any updates to this?	dated literature (e.g., Salas et al., 2005; Hackman, 1987) as these are seminal articles in the teamwork literature and regularly cited in teamwork papers.
3. Methodology: The paper's argument is built on a robust foundation of theory and concepts, evident in the authors' thorough exploration of teamwork, extreme teams, interoperability, and relevant training methodologies. The research design effectively employs a mixed-methods approach to generate valuable insights, and the reporting of findings from both methods is suitably intertwined to provide contributions from both the statistics and qualitative findings.	Thank You
4. Results: The paper clearly presents the findings and these are analysed appropriately. Both quant and qual findings are presented together, providing a deeper understanding of the findings. A chart has been provided to distil some of the quantitative findings; the only suggestion would be to add % breakdowns for the information so it is clearer. The conclusions of the paper directly address the research questions and flow logically from the presented results, with the authors synthesising the quant and qual findings to argue for the importance of interactive, in-person training that fosters social learning and team cohesion. They draw upon the identified themes to offer specific recommendations for training design and implementation.	Thank you for your suggestion. Percentage breakdowns have now been added to the chart.
5. Practicality and/or Research implications: The paper has practical implications for training design and implementation within the UK Emergency Services, as well as directions for future research. These implications are consistent with the findings and conclusions derived from both quantitative and qualitative data.	Thank You. We have further strengthened these comments in the discussion as described above.

6. Quality of Communication: The authors strike a good balance between using specialised terminology and providing clear explanations, making the research accessible to readers with varying levels of expertise in this area. The paper is well written.	Thank You
Reviewer 2	
Thank you for the opportunity to review your paper exploring emergency responders perceptions of interoperability training. I think the paper will offer a valuable contribution to the literature. Please see sections above for recommendations for improvements to the paper.	Thank You
1. Originality: This paper provides a valuable contribution to the team training literature, with a particular focus on extreme teams and provides useful information both for practitioners, and for academics to guide future research.	Thank You
2a. Relationship to Literature: The paper provides a useful background into the team training literature. Why does being trained to alter coordination and reduce communication improve team performance? – it would be useful for this point to be expanded.	Thank you for your comment. We have edited this section in reference to reviewer 1's request to update the literature and now refer to a range of different training formats (see Davis et al., 2021; Gorman et al., 2025; Braun et al., 2020).
2b. Relationship to Literature: The paper would benefit from providing more context into the background of emergency service teams – at the moment it assumes a lot of background knowledge from the reader, for example, what is METHANE? What does current training emergency services are offered look like? What are the current drawbacks of it? Do different emergency services receive different training or do they receive the same training? Is different training offered to different emergency service command levels? This would give a more thorough background for people who are not familiar with interoperability literature.	Thank you for your comment. We have provided more context about JESIP and in the introduction and methodology including explanation of METHANE and the JDM (p4). Explanations of different command levels are explained in a footnote in the participants section of the methodology (p6).
3a. Methodology: Data collection methods seem appropriate for the research objective. It would be useful to provide a background into what you mean by command role, and the different command levels (operational, tactical, and strategic) – would whether participants are in a command role, and at different levels impact the type of training	Thank you for your comment. The different command levels, and the training that they receive, has been explained in the methodology and introduction sections in line with your previous comment.

they might receive?	
3b. Methodology: What was the geographic range of participants? Were they spread across the UK or clustered in a specific area?	Thank you for your comment. We did not measure the geographic spread of participants across the UK but collected data online to broaden reach. We have added a line to the participants section to clarify (p5).
4a. Results: Results are presented coherently and the qualitative findings are useful. The use of descriptive statistics seems appropriate given the sample size.	Thank You.
4b. Results: There is discrepancy in sample size between the three emergency services, but it might be interesting for the reader to provide descriptive stats comparisons between the services to get an understanding of whether any between-service differences are present.	Considering the small sample size when participants are grouped into their profession, we do not consider that any analyses would provide meaningful and reliable results. We have noted this in the limitations section (p18) and suggest that future research investigates perceptions of team training across different services.
4c. Results: The presentation of the qualitative results would benefit from being reviewed to ensure consistency.	Thank you for your comment. We have proofread the qualitative results and have ensured that it follows APA formatting.
4d. Results: Could you provide which service the participant was from alongside the quotes in the qual section?	We have now indicated which service the participant was from for the qualitative responses using a footnote on p10.
5A. Practicality and/or Research implications: The recommendations should be reviewed to ensure they are compatible with each other e.g., you recommend that future interoperability training must involve interaction between team members during training, involving scenario-based exercises that enable team members to put teamwork into practice but also recommend a blended online and in person approach – do you expect the e learning to be scenario based exercises too that facilitate teamwork?	Thank you for your comment. We discuss that e-learning should be provided in-addition to in-person training due to its benefit of being accessible and overcoming cost issues (e.g., Panigrahi et al., 2018 – p15). This is further expanded by our addition of the literature on blended learning as suggested by reviewer 1 (p15-16).
5B, Practicality and/or Research implications: The discussion would benefit from some consideration around the practicalities of different types of training e.g., the accessibility of online training versus in person. Is online training better than no training, if in-person training isn't feasible to do costs/logistics/staffing etc. Do any of your results point to this at all?	Thank you for your comment. In the limitations section of the discussion (p18), we have discussed that whilst we have identified the perceived "ideal" training type, this must be balanced with what is practical or achievable within the context of the Emergency Services being public sector organisations which face financial and capacity constraints.

5c, Practicality and/or Research implications Please provide a reflection on some of the strengths and weaknesses of the paper.	Thank you for your comment. A limitations section has now been included (see Page 18).
5d, Practicality and/or Research implications Is there any international applicability?	Thank you for this suggestion. We have now included a section on international applicability on p17-18. We discuss that the decentralised, bottom-up approach to emergency management in the UK is like that of countries such as the US and Australia. We have recommended that research to map and compare these different interoperability systems would be useful for developing best practice guidelines.
5e, Practicality and/or Research implications The conclusion of "good interoperability training" feels a bit weak – your study explored perceptions of training so changing this to reflect that would be useful e.g., "interoperability training that is perceived as most useful/valuable etc."	Thank you for your comment. We have now updated our conclusion to reflect that we explored perceptions of training (p19).
5F, Practicality and/or Research implications I'm not sure if you can claim what is and isn't effective interoperability training as you didn't test this – you explored people's perceptions of interoperability training.	In the limitations section, we have discussed that we measured perceptions of training usefulness, rather than objective outcomes of efficacy. We have also included recommendations on how future research might further triangulate measures to assess other variables using the Kirkpatrick (2016) model (p18).
6. Quality of Communication: The paper is well written and easy to read. The arguments are well-structured and presented clearly. The paper would benefit from an overall review to check for typos and grammatical errors e.g., Page 2: "exploring team processed".	We have fully proofread the manuscript as a team to identify and correct any typos or grammatical errors.