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Responding to Emergencies:
An Experiment in Facilitating Professional Development by Means of Big Qualitative Data

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Abstract

This article reports an experiment in turning more than 300 recorded calls to an emergency response centre into a visual data format for the purpose of facilitating a process of collective exploration and learning among a group of emergency responders. The article begins by introducing an emerging experimental and interventionist practice in digital STS that inspired the experiment. In the next section, it explores the unique nature and organization of work in an emergency response centre. The article proceeds with a description of how we prepared data and a workshop, followed by an account of how the emergency responders engaged with the data and data visualizations during the workshop. In the final section, the article discusses the opportunities and challenges of pursuing an interventionist STS approach using organizational data and participatory engagement of actors in a high-stake professional environment. We argue that a meaningful integration of new forms of data requires careful consideration of both technical affordances and organizational contexts. We also point to the inherently unpredictable ways of professional groups' engagement with and use of data, specifically the emergency responders' persistent efforts to reconfigure both data and methodology.

Keywords

Participatory Data Design; Emergency Response; Experimentation; Digital STS.

Introduction: What To Do with All the Data?

Since the 1990's the datafication in the world has taken a steep upward turn creating a situation where digital mediation along with the incessant creation of data traces is increasingly permeating almost all part of our societies (Mayer-Schonberger & Cukier, 2013). The ever-evolving digital transformation of society has also given rise to a broad variety of discussions about the intended and unintended consequences for citizens, organizations, societies and democracies (Ruppert et al. 2017). In these discussions, several authors have pointed to an overall 'vibe shift' that seems to have taken place between the 1990's where the rise of the internet was broadly believed to have an inherently democratizing and liberating potential (Pentland 2008) to the 2010's where discussion increasingly moved towards concerns about the rise of surveillance states and surveillance capitalism (Crawford 2021, Zuboff 2019). In this decade, the emergence of a new generation of AI systems has added both new promises and new concerns to the discussions about the digital transformation of society: Hopes for dramatic improvements of the value created out of 'big data', but also fears of algorithmic bias, new arms races and uncontrollable environmental impacts (Runciman 2023).

Many researchers directly or tangentially related to STS have contributed to the broader public and academic discussions about digital transformation (e.g. Boyd & Crawford, 2012; Latour, 2007; Ratner & Schrøder, 2024; Ruppert et al., 2013; Suchman, 2023). But since the 2000s, researchers in digital STS have also developed what might be called a more focused experimental and interventionist practice: Through a stream of projects anchored in European STS groups, researchers have built digital tools, developed analytical styles and created workshop formats for the purpose of creating data projects in collaboration with external stakeholders invested in specific fields or controversies. One of the late outcomes of this experimental practice in STS is the so-called *participatory data design* approach, which is the inspiration for the experiment presented in this article. In the following

we provide some further background to the approach.

The Participatory Data Design approach is born out of some of the earlier frustrating experiences in digital STS. In the late 1990s, at a time of widespread positive hope about big data, a group of European STS researchers and data scientists created the Mapping Controversies on Science for Politics (MACOSPOL)[1] project (2008-2010) to map how controversies such as debates about vaccine skepticism or climate adaptation played out online (Munk et al 2019). The MACOSPOL project made considerable progress with developing tools for harvesting, analyzing and visualizing online data. In that sense, the project fulfilled its purpose. The project's ultimate goal was to create tools for the public to map and navigate knowledge controversies and teach journalists the ways in which digital tools could be used. However, the journalists already had well-established ways of overviewing controversies, which led to the failure of MACOSPOL project in this regard (ibid, p. 478)

The experiences that researchers and data scientists gained from the MACOSPOL project sparked their interest in workshop formats that ensured substantial public involvement in process of developing digital mapping instead of merely providing the public with ready-made tools and maps toward at the final stage of the project. One ambitious example of user-involvement was the EMAPS[2] (2011- 2014) project that focused on developing digital mapping of issues related to climate adaptation. Taking inspiration from hackathons and other short form workshops, the EMAPS planned a five-day data sprint where a group of data scientists were charged with developing a series of climate-related data projects. However, to ensure that the data projects would be relevant to people working in the field of climate adaptation, the EMAPS project contacted a selection of leading experts – in this case French climate negotiators – and invited them to act in a role like that of a project advisory board. The interplay between the external experts and the data scientists in the EMAPS project was arranged in the following

1 https://medialab.sciencespo.fr/en/activities/macospol/

2 https://www.emapsproject.com/blog/about/

way: On the first day of the data sprint, the issue experts were asked to present their account of the key issues in the climate adaptation field and thereby set the goals and direction for the subsequent digital mapping efforts that would be carried out by the EMAPS researchers. On day 3, the issue experts returned for the purpose of evaluating preliminary data projects that the EMAPS researchers had developed in the meantime. On day 5, the results of the digital mapping projects were presented to the issue experts in hope that the tools and maps would be adopted into their future practice. It was the assessment of the EMAPS participants that the type of consultation held with issue experts created a far better 'uptake' of results than in the case of MACOSPOL. (Munk et al 2019).

If the presence of issue experts in MACOSPOL was 'only at the final stage', and in EMAPS 'distributed along the way', then it would still be possible to increase the amount of collaboration between project insiders and outsiders by creating a fully joined workshop. This option was explored in several data sprints organized by the by the Techno-Anthropology lab (TANTlab) in Copenhagen since 2015 (Abildgaard et al. 2017, Jensen 2019). In these projects, issue experts participated through the *entire* process of the data sprint.

The role of digital tools and maps was a key issue identified in the joined data sprints. The researchers from TANTlab realized that the functions of digital artifacts should be similar to those of low-fidelity prototypes used in participatory design (Ehn & Kyng, 1992). For example, similar to a mock-up model made of cardboard boxes or a Lego-brick construction, the artifacts on the table or screen during a data sprint should allow the participants to quickly modify or change the construction through their joint efforts in discussing the desirable ways in which things should be designed. Therefore, TANTlab researchers and their collaborators developed certain interfaces, e.g. datascapes, that allow participants in a data sprint to quickly explore different ways of filtering and visualizing data sets.

TANTlab's efforts across several projects to engage stakeholders in digital mapping projects were formulated more formulaically in a

couple of publications that coined the term Participatory Data Design (PDD) (Jensen et al., 2017, 2021). In these publications, the aim of the participatory data approach is defined as "involving users in the development of data and data structures that can be used to describe, support, evaluate, direct and develop the stakeholders' *own* work" (Jensen et al., 2017, p. 169).

Furthermore, a participatory data design project is argued to entail the following three efforts: (1) *datafication* that involves preparing and harvesting data before the workshop; (2) *flexible visualization* in terms of digital prototypes and (3) *materialization* which refers to the stated goals of participatory data design workshops to always end by creating some kind of (digital) object, for instance a map, which can be used as a starting point for further collaboration.

Many tools and practices that were used in design participatory data design approach originated from previous European digital STS projects; however, the articles (Jensen et al., 2017, 2021) articulated connections to two other streams of work. (1) As the term 'participatory' indicates, they emphasized the Scandinavian tradition of participatory design and its use of prototyping. (2) As envisioned, participatory data design may play a significantly constructive role in the ways data is utilized in organizations. In the public sector, most of the current data was argued to be embedded in a new public management paradigm that ensured extraction and exploitation of data from professionals' practices for management control. In the private sector, management information systems similarly use such data to maintain control and ensure optimization related to performance metrics of the organization. Most of the current data use was argued to be embedded in a *new public management paradigm* that ensured extraction and exploitation of data from professionals' practices for management control. Management information systems in private and public sectors similarly use such data to maintain control and ensure optimization related to classic performance metrics of the organization. In contrast, the participatory data design articles raise the promise that professionals themselves can use big data to enrich and develop their work through the collegial exploration of data. For example, a group of employees from the Royal Danish Theater used selected Facebook data to explore and challenge their own implicit assumption about the theatre's unique qualities (Jensen et al. 2019, p. 124). However, the participatory design article also recognizes that the patterns of using data in organizations is an unpredictable process in which internal and external actors of the organization may 'capture' or interpret the digital products in unexpected ways (Jensen et al., 2019, pp. 130–132).

Nevertheless, TANTlab's researchers and their collaborators continued to pursue the prospect of using big data for professional learning rather than for management control. In 2020, TANTlab's researchers collaborated with another research group at Aalborg University (IT and Learning Design) to establish a 2-year professional master's education for people employed in Danish public and private organizations. Many students on this education have created projects that could use big data for facilitating professionals' learning (rather than top managers) in their own organizations. Furthermore, TANTlab's researchers attempted to outline various ways of moving away from the dominant paradigm of control associated with new public management. In a recent article, Madsen et al. (2025) argue that traditional control and optimization-oriented uses of data entails a limited 'data imagination', but that this imagination can be expanded by moving along four different axes. The organization may expand its data imagination by using data that is produced *outside* the organization, by using *unstructured* data, by pursuing *explorative* analytical strategies, and by deploying *generative* AI to create novel ideas. Using these approaches, the use of data may potentially move away from existing control-oriented data norms (hypothesis-driven analyses of internally produced, descriptive, tabular data) towards collective exploration and learning.

The ambitions of participatory data design and expansion of data imaginaries may raise the hope of novel and constructive uses of data. However, it is also clear that many questions remain unanswered. In every single case it remains a practical/organizational challenge to

prepare data and arrange a situation where professionals can engage with data and hopefully arrive at a meaningful outcome. It also remains notoriously difficult to predict how the ideas generated during a data workshop will travel and be taken up by members of the organization. And finally, as societal discussions about digital transformation continue to evolve, the evaluation of a participatory data design project cannot escape from being related to contemporary issues such as data ownership, security and surveillance. For all these reasons, there is still plenty to learn from analyses of specific experiments with creating participatory data design such as the one reported in this article.

The outline of the article is as follows: Section 2 describes the experiment through a glimpse into the work of emergency responders in the emergency response centre. Section 3 presents how data and data visualizations were prepared before the experiment and how the interaction between the emergency responders and the data was staged. Section 4 showcases the experiment's results in terms of emergency responders' interpretation of the data and the possible uses of data they proposed. Section 5 discusses how big qualitative data can facilitate professionals' development collectively, emphasizing the emergency responders' mobilisation of their domain knowledge, and their creative adaption of data and the experimental set-up. Finally, Section 6 concludes the article.

The Experimental Set-up

This study comprised a group of staff members from an emergency response centre[3] located in the Greater Copenhagen area. This centre covers 1.5 million inhabitants, receives 900 calls per day[4] on average, and remains staffed 24/7. The essential task for emergency responders is to respond to the calls, extract the caller's address and the nature of the emergency and quickly relay this information to departments of medicine, police or fire. However, such a description fails to capture the complexities of the actual work, or the cognitive and emotional strain on the emergency responders. During a 12-hour shift, an operator may experience anything from a frightened women calling while her violent ex-partner is hammering on her door trying to break into her apartment, a teenage boy waiting for the bus who suddenly finds himself to be the only by-stander to a heart attack, or an elderly man waking up to the strong smell of smoke coming from his neighbor's apartment. The emergency operator, who is steering people through these crises, is also likely to experience long periods with no calls, mistaken calls, false alarms, or even pranks. But after every call, he must attempt to clear his mind and be ready for the next. In fact, he must brace himself for the possibility that far worse and far more complicated things can happen, such as a multiple-vehicle accident on a busy street under severe weather conditions, a large-scale building fire, a chemical accident or an act of terror. In the back of his mind, he will also be aware of past events where confusion and accidental mistakes caused critical delays to rescue efforts, and he may even be haunted by stories told by his colleagues such as the account of how an emergency responder stayed on call with a man trapped in a burning building until the very end.

Despite the drama and the unpredictability of emergencies, the task of responding to emergency calls is also the everyday work for emergency responders. It is therefore also extremely well prepared, predesigned and technologically supported. One visible sign of careful preparation is the room in which the emergency operators are located. The room is a well-protected space, located behind several locked doors in the middle of a building that also holds a fire station. Despite the high security, the feel of the room is entirely different than that of a dark war room in a military bunker: The Emergency Response Centre is bright, spacious and has natural light coming from windows in the ceiling. The individual workspaces of the emergency responders are also very different from the call centers that one may find, for instance,

3 The technical term is People Safety Access Point (PSAP).

4 The number of calls varies considerably in terms of the time of the day (e.g. morning traffic) and week (e.g. Friday night partying), weather conditions or other major events that affect social activities (e.g. New Year's celebrations or COVID-19).

in a customer service department. Rather than being crammed into cubicles, the responders each have a large desk with three large curved screens arranged in a semi-circle. There is amble space between the work stations, allowing the responders to see their colleagues, while not being disturbed by them.

Each workstation is carefully organized with devices that support the responder in extracting the right information and relaying it accurately. Apart from the headset, a responder's primary tool is an in-house platform that integrates various mapping and advanced mobile location-tracking technologies. As soon as a new call starts, a monitor displays the caller's location and nearest address. Most often, the responder quickly asks the caller to confirm this information or gathers the information he needs to fill out an electronic form with the address, emergency code unique to the types of emergency and other key details. This electronic form is a data collection instrument as well as the mechanism enabling the responder to hand over the emergency to an ambulance service, police, fire and rescue services or a combination of these.

The basic craft of being an emergency responder is learned during a 6-week training program that involves attending to classroom instruction, shadowing other experienced emergency responders and taking calls while being supervised. Furthermore, their foundational training includes technical walk-throughs of the various operator-support systems, emergency protocols, communication techniques and local geographical circumstances to help responders manage the uncertainty of emergency calls.

Emergency responders continuously receive experience-based training through debriefing meetings after massive or complex incidents that may affect them emotionally. Furthermore, they attend technical and procedural refresher courses to ensure consistent performance in handling emergency calls. Many informal learning opportunities are also created by the fact that the emergency responders form a community of practice (Lave & Wenger 1991); they continually shares stories and reflections about their work, and the physical organization of the work in the Emergency Response Centre allow the responders to have sense of how other competent members of the community solve their tasks. However, despite these individual and collective modes of learning, most emergency events are managed individually and are soon forgotten while the emergency responders prepare themselves for the next call. Many issues about balancing communication and prioritizing information can be hard to pinpoint and bring up in collegial conversations.

Methods and Preparations for the Experiment

The aim of the experiment that we report in this article was to use contemporary data and computational opportunities to capture some of the more fleeting events of the emergency response work and make it an object of collective reflection. This section outlines the experiment's methodological steps and considerations. It describes technical preparations for the experiment, such as the necessary precautions related to sensitive emergency data, and the transformation of raw audio to flexible visualization (Jensen et al., 2021).

Primarily, this experiment aimed to provide a new perspective on emergency responders by transforming their sequential experiences of typical emergency calls into comprehensive visuals. During their routine work, busy responders clear their minds after each call to remain ready and focused for the next; however, this experiment attempted to capture the totality of conversations in a flexible network visualization to facilitate a collective professional dialogue and reflection about emerging patterns and themes of the emergency calls. This shift from immediate response to reflective analysis creates a joint learning space for operators to examine their practice holistically rather than sequentially.

The experiment integrated technical data processing with activities involving participation and social engagement to gain insights from unused data, ensuring that the findings remained operationally realistic, relevant and relatable for experts in emergency response centres.

The experiment connected computational text analysis with human interpretation and organizational learning through several phases. The initial datafication, which was conducted through a critical selection process, transformed audio recordings into analysable data. Notably, the distribution of different emergency call types was uneven across the different emergency services (e.g. healthcare, police and fire and rescue services), and most of the calls were related to healthcare. To ensure a nuanced and representative sample of emergency calls, a few hundred emergency calls of varying durations and times were selected to capture a representative sample, including calls in languages other than Danish. This sample size was large enough to identify meaningful patterns and balance practical processing constraints with sufficient volume.

Emergency calls require significant consideration in terms of ethical and privacy concerns. Hence, all personally identifiable information was removed, and the data was securely stored on local servers. Data was accessible only to the project leader and one IT resource. All emergency responders worked at the emergency response centre, and they had a clear understanding of working with this type of information.

The next step was transcribing the selected emergency calls to convert the audio files into a text format. Although numerous public transcription solutions are publicly available, the sensitive and private nature of emergency calls requires strict information security protocols. Therefore, the transcription process was conducted locally to ensure compliance in terms of security. A collaborator, providing digital emergency support solutions, contributed with the transcription model to the emergency response framework. This partnership ensured contextual understanding of the operational environment and adherence to security requirements for local processions' capabilities.

The selected transcription model was based on Whisper, a language model trained on 680,000 hours of speech and capable of multiple languages (Radford et al., 2022). Multilingual functionality is a crucial parameter, as emergencies affect everyone, regardless of their linguistic backgrounds. A key feature was the model's ability to understand language from poor-quality or noisy calls. As an example, one might envision the chaotic soundscape of a drowning incident in the popular party area of the Copenhagen harbour on a buzzing summer night, where an emergency caller tries to manage the situation while communicating with emergency services. Situations such as a person's sudden cardiac arrest with CPR or ongoing criminal activity may impact the call's soundscape and the transcription model's ability to accurately capture the spoken content.

While careful inspection of individual transcriptions of emergency calls may be interesting and lead to new insights, this type of learning practice is not significantly different from the responders' established foundational training. To facilitate a *new* way of learning based on collective reflection on work of the entire community, the experiment aimed to leverage larger data volumes to uncover broader patterns of practice. Therefore, the transcriptions produced by the Whisper language model were stored as individual CSV files and subsequently merged into a comprehensive dataset for natural language processing (NLP) analysis and visualization.

For NLP, the following two text processing algorithms were used: term frequency–inverse document frequency (TF–IDF) and CountVectorizer. TF-IDF is a statistical model that evaluated the importance of words within individual calls against the complete dataset across all transcribed emergency calls (Kim & Gil, 2019). This approach systematically diminished the significance of frequently appearing terms, weighing them as less informative for distinguishing call characteristics (Leskovec et al., 2014). This methodological choice aimed to observe 'beyond the obvious' textual patterns, highlighting terms of special significance in specific emergency contexts that are uncommon in general texts.The CountVectorizer algorithm was used to provide a straightforward overview of the individual words across all the transcribed emergency calls, offering a representative overview of the individual words and their frequency throughout the dataset (Pratyask, 2021).

Implementing the two algorithms required several preparatory

ID	Top terms
1	Suspects, tells, gas, cooling, other
2	Tells, gas, smell, kind
3	Hvidovre, out there, suspects
4	Nørrebro station

Table 1. Top terms when applying TF–IDF

ID	Word	Occurrence
1	Speaks	71
2	Rehabilitation centre	1
3	Hallo	48
4	Yes	1359
3693	Port ran	1

Table 2. Results of CountVectorizer application

steps to optimize the outcome. Preprocessing the dataset involved tokenization rules to split emergency conversations into smaller units of text strings so that the data could be processed by the algorithms. Furthermore, a well-prepared stop word list, aimed to filter out the most common and uninteresting filler words, ensured a balance between relevant words without unintentionally omitting others (Birkbak & Munk, 2017).

The project leader (the first author) chose these easily explainable TF–ID and CountVectorizer algorithms to avoid diverting from the 'original' data of the transcribed calls. The aim was to present the emergency responders with novel yet recognizable or relatable data rather than something 'weird' to let the responders' feel a sense of control over the material.

Having transformed the audio files of emergency calls to text through transcription and applying the two algorithms, the experiment proceeded to the next key element of the participatory data design approach: the creation of flexible visualizations (Jensen et al., 2021) to ensure domain experts' engagement with data without being overwhelmed. In this experiment, a network graph was used, which is a common visualization method among PDD practitioners (Jensen et al., 2021). The network graph can create an overview, guide the reader, and stimulate discussion with diverse perspectives (Venturini et al., 2017). The workshop employed flexible visualization techniques via Gephi, a network graph visualization tool (Bastian et al., 2009), in which adjustments were made in real time. Jensen et al. (2021, p. 127) described this practice as allowing visualizations to be *'generated quickly, displayed and enhanced in various ways, and reworked swiftly'.*

The following Gephi techniques structured the visualizations: (1) ForceAtlas2, which arranges the networks by causing repulsion among nodes (Jacomy et al., 2014) and (2) modularity algorithms that create partitions in the networks in the form of meaningful clusters (Birkbak & Munk, 2017). These methods transformed the emergency call data that had previously undergone transcription and algorithmic processes into interpretable visual patterns for explorative data analysis (Figures 1–5).

The entire visualization journey, from transcriptions of selected key words to interactive displays, helped professionals of the emergency response centre observe the data transformations in real time, highlighting participants' roles as analytical co-creators instead of passive observers (Jensen et al., 2021). Encouraging immediate responses, interpretations, and suggestions on how to manipulate visual displays reflected the participatory principle that domain knowledge should play a key role in actively shaping technical implementation rather than merely validating pre-determined analytical outcomes. Figures 1–5 show the visual evolution of the TD–IDF processed data during the workshop.

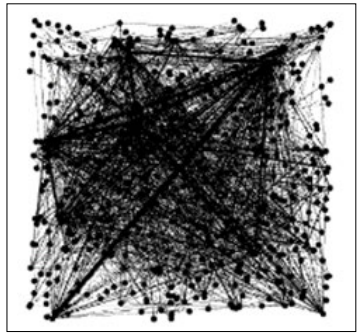

Figure 1. Raw Network File. Each node represents a top term, and each edge (line) represents a connection.

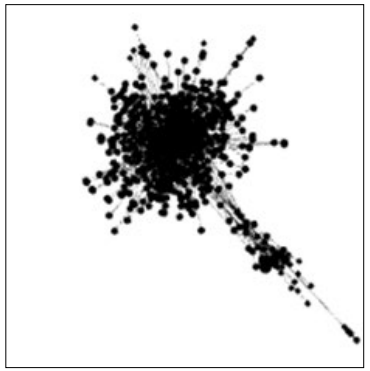

Figure 2. Application of ForceAtlas2. It pulls connected terms together while pushing unrelated ones apart, revealing clusters and relationships that might otherwise remain hidden in data.

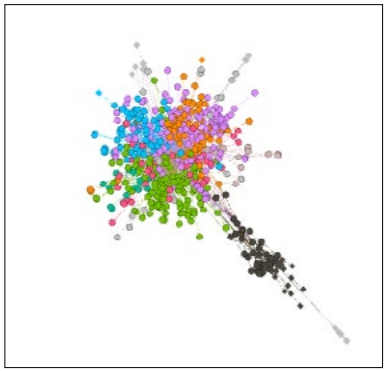

Figure 3. Application of Modularity. Communities are detected by identifying groups of terms that connect more closely to each other.

Figure 4. Visualization of Top Terms through Text Instead of Nodes

Figure 5. Final Network Graph for Further Exploration

To demonstrate emergency responders' engagement with network visualization, the concept of data sprints was used (Munk et al., 2019), responders were invited to the workshop to engage with and discuss the data. At the workshop, the project leader attempted to steer the participants' input into specific reflections, creating a structured yet dynamic environment that could insure the collaborative exploration of emergency call data's network visualization. In this process, a large screen that displayed flexible visualizations was used as a common reference point for the collective data exploration (see Figure 6).

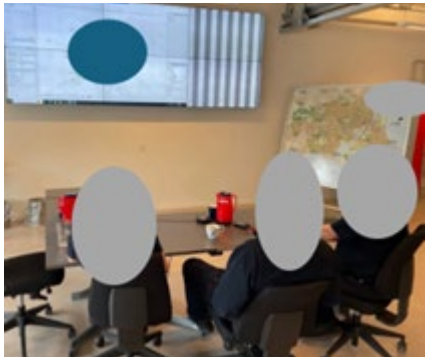

Figure 6. Picture from the Workshop

However, the responders raised the issue that the workshop was time consuming; hence, it was unsuitable for the operational realities of emergency services in which most staff members – especially those working in emergency response centres – were working shifts in operational roles. Therefore, the process continued in a 'star race'[5] format in which the participants were not all sitting together at a workshop, but where the project leader instead moved iteratively between different participants and analytical phases.

Results: Substantiation of Professional Reflections through Qualitative Data

In broad terms, the data experiment can be described as a dynamic interplay between technological capabilities and domain expertise, with Emergency Response Centre professionals actively shaping both the

5 A 'star race' is an orienteering sports activity in which movement starts at a central hub, then runs to a checkpoint and returns to the central hub and so on.

interpretation of data and the direction of analysis. In the following, we describe in detail how three Emergency Response Centre professionals (1 manager, 1 IT-responsible Emergency Response Centre -operator and 1 full-time operator) engaged with the transcribed emergency calls and network visualizations during the workshop. We highlight the insights that emerged, and how these insights evolved into practical suggestions for organizational improvement.

Initial Engagement with Transcribed Data

The workshop's first phase briefed the participants about transcribed emergency calls, and their immediate reactions revealed tension between technical possibilities and operational requirements. Jensen (2020) described an initial confrontation, such as that with transcribed emergency calls, as a 'trading zone' where communities come together and test possible connections between theories, tools and projects.

First, the participants expressed scepticism about transcription quality. One experienced operator stated, '*It depends on the quality of the transcription. For me, that's strikingly important for whether I can use it for something or not*'. The manager expressed concerns about trust: '*If we know in advance what it translates, what we factually know we're saying is wrong, then it creates distrust...*' These reactions from participants aligned with those in other participatory data design projects, where the introduction of data was considered a 'risky path' for exploring difficult questions (Jensen et al., 2021).

The workshop dynamics shifted significantly when participants encountered high-quality English transcriptions. An operator exclaimed, '*That's incredibly good*', while the other noted, '*That's an entirely different product*'. This moment marked a shift from scepticism to constructive engagement, and the operator immediately identified a practical application:

> '*If you took the English speech as your starting point, you could actually get something out of it, especially as an alarm operator, regarding the different levels of English competencies...*'

This observation directly addressed potential training and quality improvements, demonstrating how domain experts quickly moved from evaluating the technology to envisioning its application – an example of a stimulated data fantasy (Ørngreen et al., 2023). Another significant moment occurred when an operator identified a specific communication pattern in a transcription:

> '*It's so clear, without hearing the conversation and just by reading it, that she's calling about a medical situation, and the first thing the operator asks is which address they're calling from. And the reaction [from the caller] is, "uh, what?" It would be interesting to see how many times we get such a reaction from a caller...*'.

The context that this transcript indicates is that the operator seems to lack empathy in the conversation, demonstrating how the transcribed calls allowed the observing operator to step back from individual emergency management and observe aggregate patterns in their communication practices. This was precisely the shift in perspective the experiment sought to facilitate, going from individual assessment to collective reflection among participants in the same community of practice.

The project leader then introduced Gephi network visualizations that represented a condensed view of hundreds of emergency calls, creating a new analytical space for participants. Traditional quality assessment typically involves reviewing individual calls; however, Gephi visualizations enabled participants to observe and reflect upon communication patterns across the entire corpus simultaneously.

Based on TF–IDF-processed data, the first network visualization (Figure 5) was spatially arranged using the ForceAtlas2 algorithm (Jacomy et al., 2014), which immediately generated opposing interests

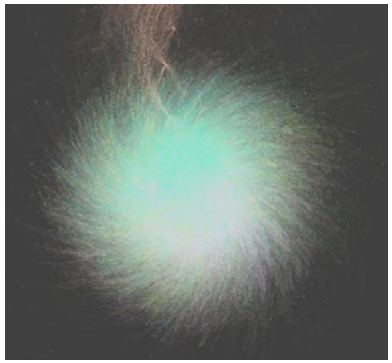

Figure 7. Gephi Visualization Based on Emergency Call Data Processed by CountVectorizer

among participants. One participant was drawn to outlier nodes, saying, '*I'm curious about where it's diverging*', while another participant focused on the centre: '*Yes, I have the exact opposite reaction. I'm very curious about what's right in the centre*'. This contrast exemplified what Birkbak and Munk (2017) referred to as 'network spaciousness', the capacity of network visualizations to accommodate different interpretative approaches simultaneously. The participant elaborated on his interest in outliers:

> '*What makes me curious about where it diverges is that it diverges so much. Is it a conversation that has completely gone off track, where there's actually something that could be improved?*'

As the workshop progressed to visualize data processed using CountVectorizer, the resulting network appeared significantly complex, with a large central cluster and a distinct smaller cluster.
Participants focused more on the frequency of small everyday expressions scattered all over, such as 'I see' and 'now listen carefully', than on structural features. Their observations of these small everyday expressions prompted reflection on operator communication protocols. The manager noted: '*This perhaps shows that we don't really have fixed frameworks for this...*'. Once again, the responders connected visual observations to potential quality improvement initiatives in operator training.

As participants grew comfortable with the network visualizations, significant insights emerged that addressed improvement in quality and training opportunities. The following three themes dominated these discussions.

First, participants were surprised by the occurrence of communication using the English language. One participant observed:

> '*One of the things that surprises me is that 10% of our calls are conducted in English. And then we're back to whether we can get a tool in our call taker [system] that can help our operators, even though English proficiency is a requirement when they apply, we can always support them better'.*

This insight led to concrete suggestions for technology-assisted multilingual support systems – a direct materialization of the data exploration process that aligns with the observation of Jensen et al. (2021, p. 129) that '*The goal of producing material outcomes toward the end of a project is another way to propel participants to create something, which can be an object of negotiation and collaboration'.*

Second, the participants noted variations in opening question sequences and their impact on caller comprehension. The visualization showed that asking for location first confused callers and neglected their medical concerns. This insight prompted discussions on refining protocols to enhance caller–operator engagement.

Third, the analysis of communication patterns revealed significant variations in how operators formulated similar information requests, raising questions about standardization versus adaptability in emergency communication. One participant reflected on the training implications:

> '*It becomes quite clear that what we do the first 4–5 months, when we hire new people, is try to train them to handle things uniformly, both in formulations and such. It's clear that there's certain words as "emergency centre," everyone says that, but there are some fixed formulations that stand*

out with keywords like "please." It could be interesting to pull some data and see how friendly and service-minded we've become. If we pulled a couple thousand calls from five years ago versus February this year, is there a tendency toward a change in tone and formulation that appears a bit more positively inclined or service-minded?'

Perhaps the most unexpected outcome was the manager's proposal to incorporate these network visualizations into the daily work environment by hanging printed network visualizations on the walls of the emergency centre:

'*It would be fun to visualize this inside [the physical Emergency Response Centre], but then visualize it so people [Emergency Response Centre staff] could see what words we use the most and how they're connected.*'

This suggestion moved beyond isolated analytical insights to envision ongoing reflection integrated into daily operations. The manager elaborated on the potential workplace impact:

'*I think visualizing it also brings out the mindset. So, if you see that when you come to work, then it's clear when you're at work... you see that there's a focus on how we communicate, and that is something you want to look at.*'

The manager emphasized that visualizations can transform performance evaluation from a one-sided assessment of operators to a balanced understanding of communication dynamics, including how callers interact with operators:

'*So that as an operator, you feel that it's not always them being evaluated, but now it's also visualized how people talk to them...*'

This observation showed that visualization-driven insights can contribute to operational improvement and well-being in the workplace.

Participants shifted from viewing emergency calls as sequentially managed, isolated incidents to a collective practice with identifiable patterns. A busy operator typically '*clears their mind after each call to remain ready and focused on the next',* as one participant noted, the workshop created a space in which operators could collectively examine conversations to identify patterns worthy of professional discussion and reflection, representing one of the most significant effects of the experiment. By transforming previously inaccessible audio recordings into analysable text and visually explorable networks, the experiment offered a new perspective on emergency communication. A perspective that encouraged and enabled the participants to think about themselves as a community of practice, and a perspective that made visible patterns that would remain invisible when calls were considered individually. This vantage point facilitated the identification of systemic improvement opportunities rather than isolated performance assessments.

The participants' ability to recognize familiar patterns while discovering unexpected connections stimulated their engagement throughout the workshop. By confirming operators' experiential knowledge, such as the challenges of multilingual communication, visualizations validated the analytical approach and practitioners' tacit expertise. Surprising patterns in visualizations, such as the diverse range of opening sequences, prompted productive reconsideration of established practices.

Summary of results

The participants concluded that the insights gained represented a foundation for ongoing quality development and showed interest in applying the methodological approach to other aspects of *emergency response centre* operations like radio communication, indicating that the experiment offered a valuable perspective on how unstructured data could enhance professional knowledge development.

Combining NLP techniques with flexible visualization and participatory interpretation, the experiment demonstrated the possibility of gaining new insights from previously unused unstructured data. The workshop created a space in which emergency response centre domain experts could step back from the immediate pressure of emergency response to reflect on their collective practice – a perspective unattainable through traditional quality assessment methods.

The key outcome was recognizing that exploratory data analysis and visualization could be ongoing components of quality development rather than isolated exercises. As the manager suggested: '*Visualize it so operators could see what words we use most and how they're connected'.* This vision of integrating data exploration into daily professional reflection shifts its role from treating data as management information to a resource for practitioner learning and development.

The experiment showed how NLP and visualization can provide insights from emergency call data and how participatory data exploration can transform emergency response centres' approach to quality development, from individual performance assessment to collective professional reflection and development.

Discussion

The experiment aimed to utilize previously underused unstructured data for professional development at the Emergency Response Centre. This led to a pragmatic understanding of using unstructured data in the Emergency Response Centre and several ideas and outcomes highlighted earlier. The experiment also raised new perspectives on what might happen with and to the participatory data approach when it is engaged by a self-confident community of professionals.

This section discusses three interconnected dimensions of the experiment that all emphasize how the participatory data approach was translated in the meeting with the organization and the practitioners.

Moving towards a Star Race

Following the practice of previous PDD project, the experiment was first organized as a workshop. The responders' participated in this but soon suggested that continued work with the data should accommodate the operational contingencies of the emergency center with responders working shifts and taking on operational roles that would not allow them to schedule a workshop. Hence a star race-like organization emerged, where the project leader would move between data work and ad hoc consultations with the responders. This development of the organization of the project, was a small step in the context of the emergency centre, but a significant new move in the organization of participatory data design projects. As we described in the introduction, previous projects have involved practitioners either at the very final stage (MACOSPOL), intermittently (EMAPS), or in a fully joint workshop (TANTlab). However, the idea of making the project leader run a star race was a novel concept worth exploring in future projects.

Situated Interpretation of Data

When the emergency responders encountered the transcription of the calls, they immediately compared their existing knowledge to the quality of the transcript. They were impressed by the English transcription but sceptical about parts of the Danish one. Familiarizing themselves with the data and interpreting its quality was the first step before discussing extracted data (word lists) and visualizing the connections between words. Exploring the basic data was crucial to establish responders' sense of control. Notably, the responders did not reject the data or the project due to errors. They developed a sense of how much data could be trusted and where to supplement it with their own knowledge. This allowed them to work with data that would have been untrustworthy if shared with external partners lacking insight into the emergency response. Data that would be dubious and potentially misleading in a new public management set-up was thus made more

valuable by the participants in the context of a PDD project. Future participatory data design projects should therefore consider investing time and effort in facilitating participants' engagement with basic data to understand its potential and limitations.

From Individual Assessment to Collective Reflection

A key outcome of the project was the responders' suggestion to display the data visualizations on the emergency centre wall. This practical and symbolic act would signal that communication was both key and a collective concern. The data visualization would not address the problem individually by assessing how well responders complied with the protocol. Instead, the visualization of collective communication would indicate a shared interest in its evolution and the callers' contributions to communication patterns. In this way the data visualization would become yet another resource that allow the individual responder to develop a sense of how the community was working. As the social learning theorists Lave & Wenger (1991) have argued, the physical arrangement of transparency allowing practitioners to have a sense of the entire community's work is crucial to effective learning processes.

A possible lesson for future participatory data design project may be to carefully consider *who* to design for. In previous workshops, individual participants in data sprints have proposed ideas that would be directly useful to their own practices. As an example, a nutritional researcher participating in a workshop in TANTlab, proposed analysis of a set of data, that would support his ongoing line of research (Elgaard Jensen et al. 2019). There is nothing wrong in that. However, the emergency responders' proposal of a data visualization of the collective communication, indicates the potential of designing for communities of practice.

Conclusion

In this article we have described an experiment in using big qualitative data as a resource for collegial reflection and development within a community of emergency responders. The background for the project was the general rise of computational opportunities and 'big qualitative data' (Mayer-Schonberger & Cukier, 2013) as well a distinct experimental and interventionist tradition that has emerged in STS in since the 2000s' (Munk et al. 2019, Jensen et al.2021).

The experiment in the emergency response center demonstrated that a participatory data approach can generate pragmatic, implementable suggestions for organizational improvement; The participants envisioned specific applications from technological aids for multilingual communication to visualization-based reflection tools.

The emergency responders' active engagement with the project also gave rise to several new insights and suggestions for how to practice participatory data design in the future. They occasioned a new ("star race") project organization, and they demonstrated how situated interpretation of data by local experts can retain value that would be lost if data was abstracted and given to outsiders. Finally, they called attention to the value of creating data projects that support communities of practices rather than individual needs.

Taken together, the experiment in the emergency centre demonstrated the possibility of a progressive and productive use of big data. While deploying a range of newly developed tools for transcription, NLP and visualization, the project carefully respected data confidentiality and insisted that the community of professionals should remain in control of how the data and computational opportunities were used. In this way the experiment, could be read as a small contribution to the wide-ranging contemporary debates about desirable data futures.

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Bios

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