Original paper

'Tell me exactly what's happened': When linguistic choices affect the efficiency of emergency calls for cardiac arrest☆

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ABSTRACT

Background: Clear and efficient communication between emergency caller and call-taker is crucial to timely ambulance dispatch. We aimed to explore the impact of linguistic variation in the delivery of the prompt "*okay, tell me exactly what happened*" on the way callers describe the emergency in the Medical Priority Dispatch System®.
Methods: We analysed 188 emergency calls for cases of paramedic-confirmed out-of-hospital cardiac arrest. We investigated the linguistic features of the prompt "*okay, tell me exactly what happened*" in relation to the format (report vs. narrative) of the caller's response. In addition, we compared calls with report vs. narrative responses in the length of response and time to dispatch.
Results: Callers were more likely to respond with a report format when call-takers used the present perfect ("*what's happened*") rather than the simple past ("*what happened*") (Adjusted Odds Ratio [AOR] 4.07; 95% Confidence Interval [95%CI] 2.05–8.28, p < 0.001). Reports were significantly shorter than narrative responses (9 s vs. 18 s, p < 0.001), and were associated with less time to dispatch (50 s vs. 58s, p = 0.002).
Conclusion: These results suggest that linguistic variations in the way the scripted sentences of a protocol are delivered can have an impact on the efficiency with which call-takers process emergency calls. A better understanding of interactional dynamics between caller and call-taker may translate into improvements of dispatch performance.

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Introduction

When a bystander calls for an emergency ambulance for a time-critical life-threatening condition, such as an out-of-hospital

cardiac arrest (OHCA), they face the difficult task of describing a distressing situation to a call-taker. A call for an OHCA is the epitome of situations in which efficient and clear communication between caller and call-taker is of the utmost importance, because it may influence recognition of OHCA, rapid ambulance dispatch, and initiation of early basic life support until the paramedics arrive on the scene. In the case of OHCA, every minute counts [1], thus any delays arising from the call may impact on patient outcomes. As a result, research on dispatch has identified the need to analyse the linguistic features of the call [2].

To date, research analysing the language used in OHCA calls has largely focused on callers' use of specific keywords as potential indicators of cardiac arrest [3–5]. While this addresses what is said by the caller, it overlooks many of the other potentially important aspects of the interaction between caller and call-taker, even within the constraints of scripted protocols. In particular, the *way* call-takers speak may influence what callers say next. In turn, this may affect the efficiency and accuracy of emergency calls. A large body of linguistic and sociological research [6–11] has demonstrated how slight variations in phrasing and delivery can escalate into serious communication difficulties during emergency calls; and a few studies have started to investigate this phenomenon in OHCA calls [2,12–14]. However, these studies have not used a theoretically informed linguistic analysis of the interactions between the call-taker and the caller.

One of the standard protocols used worldwide to process medical emergency calls is the Medical Priority Dispatch System® (MPDS [15]). Within the MPDS, the first opportunity that callers have of describing the situation is when call-takers deliver the scripted prompt "*okay, tell me exactly what happened*". This prompt initiates what may be termed the **reason-for-the-call** sequence [16,17] i.e., the part of the call in which callers are required to describe the emergency so that call-takers can determine the chief complaint and proceed with the assessment, taking the form of an interrogative series [18]. This study aimed to explore the impact of the linguistic variations in the way call-takers say the same scripted sentence (the reason-for-the-call prompt). Specifically, we examined the impact of these variations on the way callers subsequently describe the emergency and the timing of calls. The primary outcome was the format of caller response (report vs. narrative). Secondary outcomes were length of caller answer and time to ambulance dispatch.

Methods

Population

We retrospectively analysed a random selection of emergency calls for paramedic-confirmed OHCA received at the call centre of St John Ambulance Western Australia (SJA-WA) between 1 January 2014 and 31 December 2015 for the Perth metropolitan area.

Dispatch protocol

SJA-WA uses the MPDS (version 12.1.3), implemented with the ProQA software [19]. All calls start with a Case Entry sequence, with the following steps: after confirming (1) the address of the emergency and (2) the caller's telephone number, the call-taker (3) delivers the prompt "*okay, tell me exactly what happened*", and asks (4) "*Are you with the patient now?*", (5) "*How old is s/he?*", (6) "*Is s/he awake?*", and (7) "*Is s/he breathing?*", with the caller responding to each of these. Based on the caller's answers to these prompts/questions, the call-taker assigns the call to one of 32 Chief Complaints, representing the primary nature of the patient's emergency. The call-taker then uses caller feedback from a set of complaint-specific Key Questions to arrive at an MDPS dispatch code, which classifies both the nature and the likely severity of the patient's condition. After the Key Questions, the call-taker then issues any Dispatch Life Support instructions if applicable. Fig. 1 summarises the overall structure of calls using the MPDS.

Data collection

The SJA-WA OHCA database maintained by the Prehospital, Resuscitation & Emergency Care Research Unit (PRECRU) at Curtin University contains all cases of OHCA attended by paramedics in Perth, WA since 1996. A flowchart for the data collection is presented in Fig. 2. For the study period there were a total of 3513 OHCA cases recorded. We selected from the SJA-WA OHCA database all the cases of non-traumatic, adult OHCA (>14 years old) where the arrest was not witnessed by paramedics, but where paramedics attempted resuscitation. We excluded cases where there was a clear impediment to paramedic attendance (e.g., patient on aeroplane, n = 7), incidents with multiple OHCA patients (n = 9), and cases where ProQA data was unavailable (n = 49). The selected cases were randomised (using a random number generator), and the corresponding audio recordings extracted and screened one-by-one, until reaching the target of 200 calls. Listening to each call, we excluded: calls in which the patient was unequivocally conscious at the end of the call, the caller was not a layperson (e.g., the caller worked for the police or a health/care facility), the caller was not on scene, the caller and/or call-taker was not a native speaker of English, and where the sound quality was very poor. More details about data collection can be found in the study protocol [20]. We focused on the subset of these calls in which the reason-for-the-call prompt (*okay, tell me exactly what happened*) was delivered by the call-taker (189 calls) and further excluded one call in which the caller's response was unintelligible.

Linguistic analysis

The linguistic analysis combined the qualitative analysis of Conversation Analysis and the quantitative methods used in Corpus Linguistics. One researcher (MR) transcribed the calls in the software CLAN [21] following the system developed within the conversation-analytical framework [22,23], a method aimed at representing talk and encapsulating content as well as the manner of speaking. A list of the symbols used can be found in Appendix A. The transcripts were reviewed by a native speaker of Australian English (TAW). The basic unit used for transcription and analysis was the turn-constructional unit (TCU), the mainstream minimal unit used in Conversation Analysis. TCUs are the building blocks of spontaneous interaction, as they correspond to potentially complete turns [24–26].

We analysed four linguistic features of the prompt delivered by call-takers:

- Tense, i.e., whether the call-taker opted for the simple past (*what happened*) or the present perfect (*what's happened*)
- Tone, i.e., whether the final pitch contour was rising (*tell me exactly what happened*↗) or falling (*tell me exactly what happened*↘) [27], see Fig. 3.
- Tonic, i.e., which word bore the most prominent stress [27]
- Turn-initial preface, i.e., whether the call-taker used a discourse marker [28,29] (*okay*, *so*, *now*, etc.) at the beginning of the prompt.

The examination of intonation (tone and tonic) combined auditory analysis and visualisation using the speech analysis software Praat [30].

We annotated reasons-for-the-call as 'narratives' if they displayed any structural element indicative of oral narratives (orientation, complication, evaluation, resolution, or coda, defined in Appendix B) [31], and otherwise coded them as 'reports' (see Fig. 4 for an example of each type of reason-for-the-call format). Typically, narrative reasons-for-the-call contained an orientation sequence setting the scene of how the caller found the patient (e.g., "*uh I've just heard a loud bang I've jumped up and ran into the ensuite toilet*").
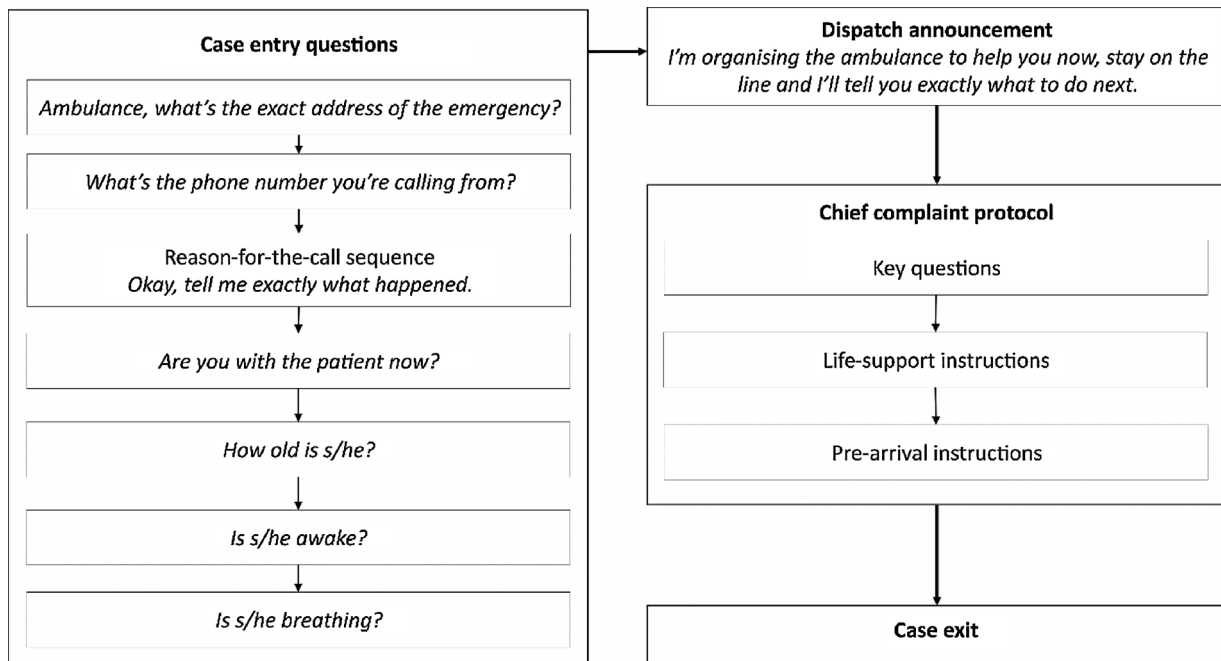
Fig. 1. Overall structure of calls with the Medical Priority Dispatch System.

Timing of dispatch

Three time intervals were measured: time to reason-for-the-call (start of the call to the end of the call-taker's reason-for-the-call prompt), length of reason-for-the-call (end of the call-taker's prompt to the start of the next Entry Question), and time to dispatch (from confirmation of the caller's telephone number to effective dispatch as recorded in ProQA).

Statistical analysis

To analyse the relationship between the format of the call-taker's prompt and that of the caller's reason-for-the-call, logistic regression was conducted in R 3.3.1 [32] using the glm() function, and odds ratios (OR) and 95% Confidence Intervals (95% CI) were calculated. To predict the format of the caller's reason-for-the-call (narrative vs. report), we included four linguistic features of the prompt as predictors: **tense**, **tone**, **tonic**, and **preface**. We also
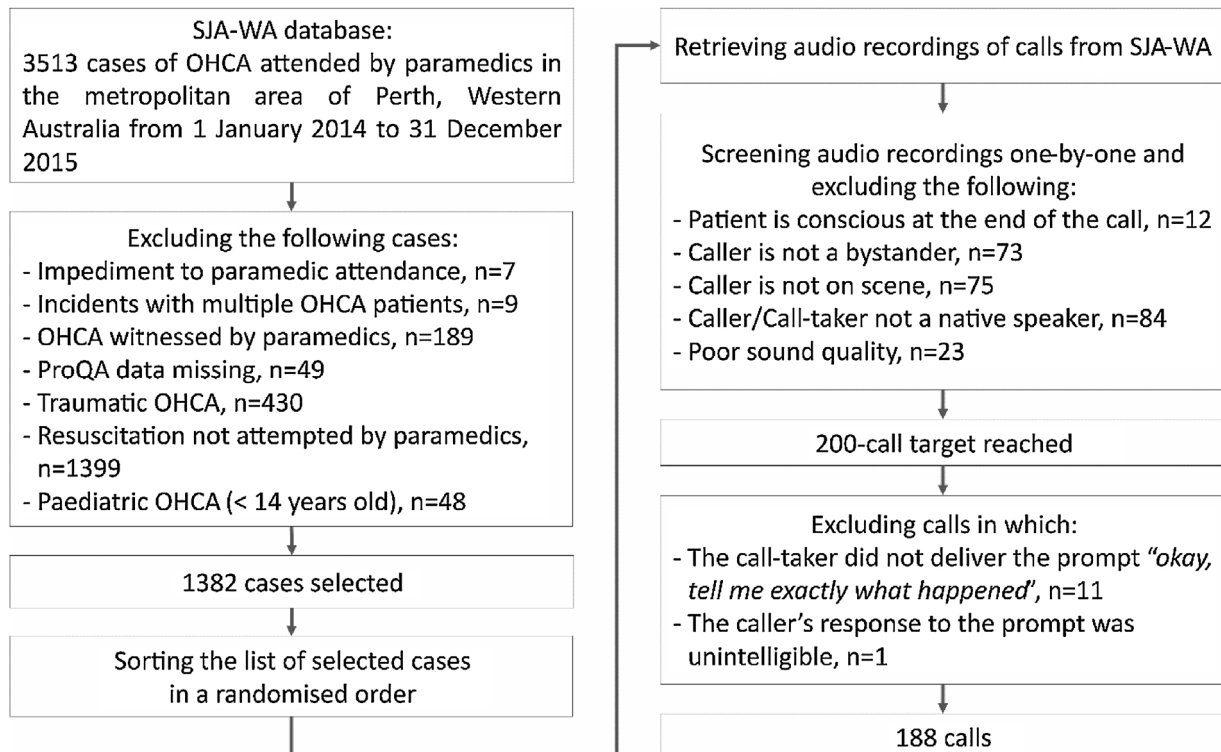

Fig. 2. Data collection flowchart.
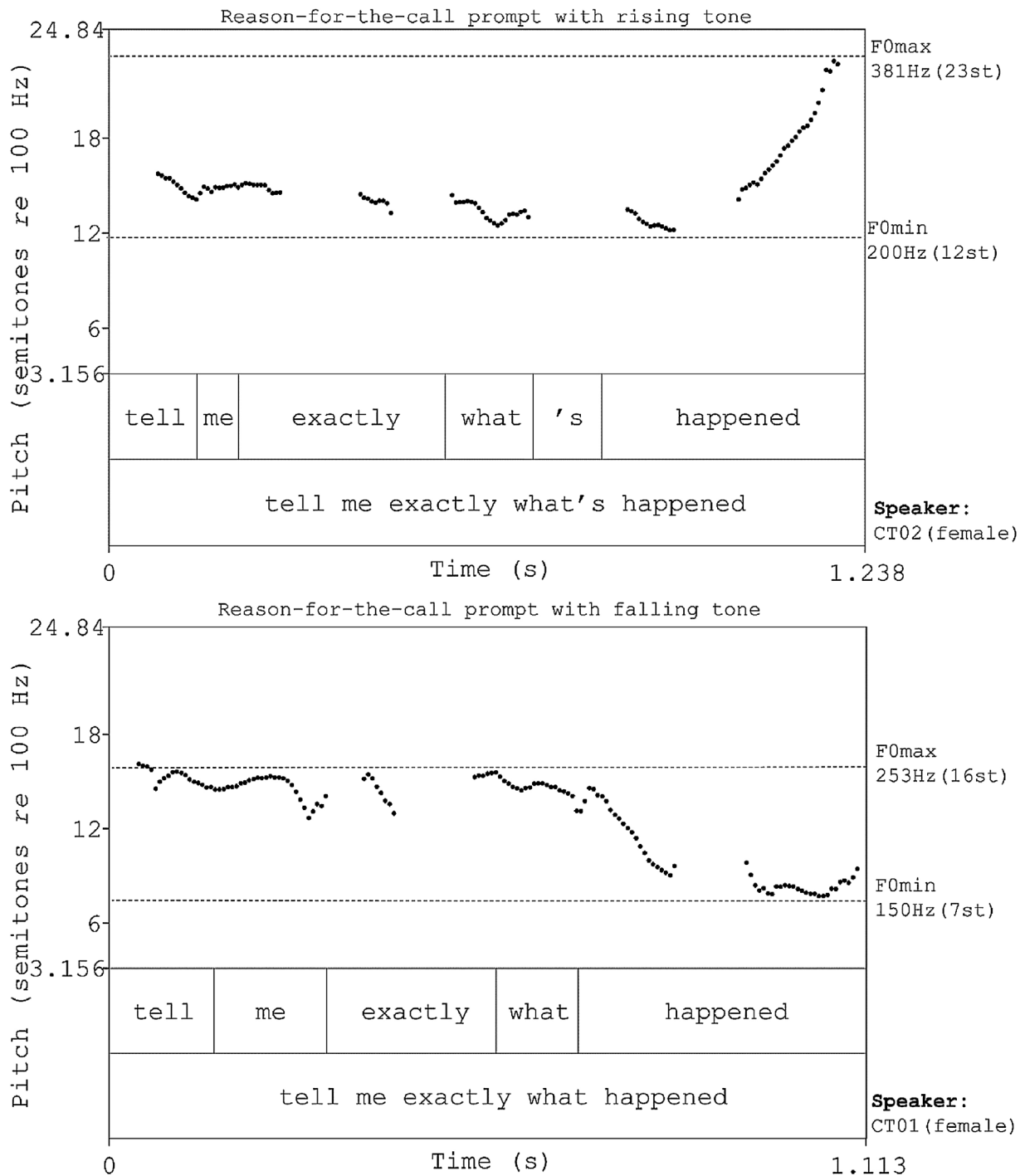
Fig. 3. Intonation of reason-for-the-call prompt.

adjusted for the following contextual and sociolinguistic variables, which we identified as potential confounders: (1) pre-emption (whether the caller volunteered a reason-for-the-call before the prompt), (2) time to reason-for-the-call, (3) gender of the call-taker, (4) gender of the caller, (5) estimated age of the caller (child, adult, elderly), (6) relationship of the caller to the patient (close relation, e.g., spouse or friend, vs. stranger, e.g., passer-by or neighbour).

The Mann–Whitney U test was used to compare the differences in medians by group (report vs. narrative) for continuous variables (time). A p-value < 0.05 was considered statistically significant.

Ethics

Approval for the study was granted by the Human Research Ethics Committee of Curtin University (HR128/2013) and the SJA-WA Research Advisory Group.

Report reason-for-the-call

```
1       CT:     and can you tell me exactly what's happened please↘
2       C:      it seems like she's collapsed↘
3               she's (.) had a stomach ache for the last couple of days and all
                of the sudden she just can't get out of bed↘
4       CT:     o:kay are you with her now↗                        (SJA201, 35-39)
```

Narrative reason-for-the-call

```
1       CT:     okay tell me exactly what happened↗
2       C:      (..) u:h hh my partner ((NAME))↗
3               who     ⌈has] (.) Alzheimer's and has had it for a while↘
4       CT:             ⌊yes]↘
5       C:      .h I took her to the toilet↗
6               (.) and we're in the bathroom↘
7               a:nd uh washing her hands and she was drying her hands and she's
                (.) turned to me and said .h I FEEL FUNNY↘
8               and she collapsed↘
9               and of course I was able to (..) catch her↗
10              she hasn't hit her head or anything else like that ((SNIFF)) ↘
11              and she is sitting (.) u:h unconscious if you like but breathing↗
12              and she- (.) breathes for a few minutes o:r or say thirty second↘
13              (.)     ⌈u::h]
14      CT:             ⌊okay] ⌈so she's unconscious↗                    ]
15      C:                     ⌊she's sitting on the floor↘        ]
16      CT:     she's unconscious at the moment↗
17      C:      (.) yes she's unconscious yes↘
18      CT:     (..) just bear with me and we'll get this into the system↘
19      C:      (.) °right°
20      CT:     (..) .h (.) are you with the patient now↗       (SJA210, 57-77)
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Fig. 4. Examples of report vs. narrative reason-for-the-call.

Results

Effect of linguistic choices on reason-for-the-call format

We found substantial variation in the way call-takers delivered the reason-for-the-call prompt (Table 1). In 60% of cases, call-takers switched from the simple past (*what happened*) of the scripted prompt, to the present prefect (*what's happened*). We found that this deviation from the script significantly increased the likelihood of the caller providing a report rather than a narrative (AOR 4.07; 95% CI 2.05–8.28, $p < 0.001$). Prompts delivered with a falling tone were more often followed by a report (64%) than those with a rising tone (51%) (Table 1). However, this positive association between falling tone in the prompt and report format of the reason-for-the-call was not statistically significant (AOR 1.97, 95% CI 0.94–4.16, $p = 0.07$) (Table 2). Moreover, the odds of the caller choosing a report format decreased by 20% for every 10 s from the beginning of the call (AOR 0.80, 95% CI 0.66–0.95, $p < 0.02$). None of the other variables were found to be predictors of reason-for-the-call format (Table 2).

Effect of reason-for-the-call format on timing

The number of turn-constructional units (TCUs) used by callers for their reasons-for-the-call was significantly shorter ($p < 0.001$) in the case of reports (median 3 TCUs, Interquartile Range 2–4) than narratives (median 6 TCUs, IQR 4–8). The length of the reason-for-the-call was also significantly shorter ($p < 0.001$) for reports (median 9 s, IQR 6–13) than narratives (median 18 s, IQR 11–26). Similarly, time to dispatch was significantly shorter ($p = 0.002$) for reports (median 50 s, IQR 35–65) than narratives (median 58 s, IQR 43–81).

Discussion

Our results suggest that callers are less likely to use a narrative response if the reason-for-the-call prompt is delivered with the present perfect tense (*what's happened*). This is congruent with the English tense system, in which the simple past is associated with the narration of past events disconnected from the time of utterance, whereas the present perfect entertains an affinity with the current situation [33–35].

Narratives are a less desirable format during an emergency call, as they tend to take longer to unfold both in terms of turns and seconds, which impacts time to dispatch. Response time provides additional context in which to interpret our findings on the timing of calls. The median time from allocation of a crew to arrival on scene was 7.0 min (10th and 90th percentiles: 3.9–11.8 min) during the study period for OHCA cases attended by paramedics and where resuscitation was attempted. Another potential issue of narratives is that they contain information that is not of primary relevance at this point in the call. In sum, the difficulty posed by narratives is that they can be less straightforward accounts than reports, which has consequences for time-management as well as the quality of information retrieval – two interrelated constraints at dispatch. From the point of view of the caller, both discursive formats (report and narrative) are relevant responses in the reason-for-the-call sequence, as their task is to convey what the situation is. However, in the context of a scripted protocol such as the MPDS, the narrative format can be detrimental because it causes delays until the next Entry Questions can be asked. Our results suggest

Table 1
Linguistic and contextual variation of call-takers' reason-for-the-call prompt in 188 out-of-hospital cardiac arrest OHCA emergency calls placed in Perth, WA between January 2014 and December 2015. Percentages are relative to column totals.

	Report	Narrative	Total
Tense			
Simple past (*happened*)	32 (28%)	42 (57%)	74 (39%)
Present perfect (*has happened*)	79 (69%)	31 (42%)	110 (59%)
Other (e.g., *is happening*)	3 (3%)	1 (1%)	4 (2%)
Tone			
Fall	86 (75%)	48 (65%)	134 (71%)
Rise	28 (25%)	26 (35%)	54 (29%)
Tonic			
<u>happened</u>	25 (22%)	13 (18%)	38 (20%)
<u>exactly</u>	79 (69%)	55 (74%)	134 (71%)
other (e.g., <u>tell</u>)	10 (9%)	6 (8%)	16 (9%)
Preface			
Discourse marker (*okay*, *so*, etc.)	69 (61%)	52 (70%)	121 (64%)
No discourse marker	45 (39%)	22 (30%)	67 (36%)
Pre-emption by caller			
Pre-emption	30 (26%)	25 (34%)	55 (29%)
No pre-emption	84 (74%)	49 (66%)	133 (71%)
Time to reason-for-the-call			
≤15 s	14 (12%)	2 (3%)	16 (9%)
16–25 s	48 (42%)	30 (41%)	78 (41%)
26–35 s	17 (15%)	19 (26%)	36 (19%)
36–45 s	17 (15%)	10 (14%)	27 (14%)
≥46 s	18 (16%)	13 (18%)	31 (16%)
Length of reason-for-the-call sequence			
≤5 s	29 (25%)	2 (3%)	31 (16%)
6–10 s	44 (39%)	15 (20%)	59 (31%)
11–20 s	28 (25%)	27 (36%)	55 (29%)
≥21 s	13 (11%)	30 (41%)	43 (23%)
Gender of caller			
Female	56 (49%)	43 (58%)	99 (53%)
Male	57 (50%)	31 (42%)	88 (47%)
NA (two callers)	1 (1%)	0 (0%)	1 (1%)
Gender of call-taker			
Female	85 (75%)	61 (82%)	146 (78%)
Male	29 (25%)	13 (18%)	42 (22%)
Estimated age of caller			
Elderly (>70 years old)	31 (27%)	28 (38%)	59 (31%)
Adult (18–70 years old)	75 (66%)	44 (59%)	119 (63%)
Child (<18 years old)	8 (7%)	2 (3%)	10 (5%)
Relationship of caller to patient			
Close	93 (82%)	59 (80%)	152 (81%)
Stranger	21 (18%)	14 (19%)	35 (19%)
Unknown	0 (0%)	1 (1%)	1 (1%)
Total	114	74	188

that use of the narrative format can be reduced by implementing a linguistic change to the existing protocol – namely in the tense used by call-takers to deliver the reason-for-the-call prompt.

We also found a non-significant association between call-takers using a falling tone and callers responding with a narrative format. We propose that the role of tone be not entirely ruled out at this stage, but that more data is needed to explore the question further.

More difficult to interpret is that the odds of callers opting for a report format decreased as more time elapsed from the beginning of the call to the reason-for-the-call. We included the variable "time to the reason-for-the-call" as part of examining whether the format of the caller's response could be related to characteristics of the call prior to the call-taker's prompt. Interestingly, while increased time to reason-for-the-call predicted a lower odds of callers' use of report format, the inclusion of this variable in the multivariate model did not remove the effect of the caller-taker's prompt (i.e., the estimated effect of tense). Thus, it appears that the effect of time to reason-for-the-call, as well as the call-taker's use of tense,

are independent predictors of the format of the caller's response. We interpret our result on time to reason-for-the-call as an indication that the very beginning of calls should be investigated further. Although our model was adjusted for some aspects of caller characteristics such as age and their relationship to the patient, it is beyond the scope of the present study to determine what specific features of the caller, call-taker, dialogue between caller and call-taker, or situation, might bear on the onset of calls.

Even though communication has long been identified as a key area of research for ambulance dispatch [2–4,14], very few studies have targeted specific linguistic features, such as turn-taking [12] and acoustic properties of the caller's voice [13]. The novel contribution of our study is to assess the effect that linguistic variants used by call-takers can have on the success of the calls, and to propose concrete changes to the dispatch protocol. More than 3000 call centres worldwide use the Priority Dispatch System®, and the prompt "*okay, tell me exactly what happened*" is also part of the protocol for Fire and Police dispatch. Our finding concerning the

Table 2
Logistic regression modelling the association between linguistic variations in call-taker prompt and the format of caller reason-for-the-call. Outcome: report format.

Variables	OR [95% CI]	AOR [95% CI]	*p* value[*]
Tense			
Simple past	1.00	1.00	
Present perfect	3.34 [1.81–6.28]	4.07 [2.05–8.28]	<0.0001
Tone			
Rise	1.00	1.00	
Fall	1.16 [0.88–3.16]	1.97 [0.94–4.16]	0.07
Tonic			
happened	1.15 [0.33–3.85]	1.02 [0.24–4.06]	0.98
exactly	0.86 [0.28–2.46]	0.88 [0.24–2.95]	0.83
other	1.00	1.00	
Preface			
Discourse marker	0.65 [0.34–1.20]	0.98 [0.48–2.01]	0.97
No discourse marker	1.00	1.00	
Pre-emption			
Pre-emption of reason-for-the-call	0.70 [0.37–1.33]	0.81 [0.37–1.78]	0.60
No pre-emption	1.00	1.00	
Scaled time to reason-for-the-call			
Per 10-s increment	0.90 [0.79–1.03]	0.80 [0.66–0.95]	0.02
Gender caller			
Female	1.00	1.00	
Male	1.41 [0.78–2.56]	1.36 [0.68–2.77]	0.39
Gender call-taker			
Female	1.00	1.00	
Male	1.60 [0.78–3.42]	1.21 [0.55–2.76]	0.64
Age caller			
Elderly (>70 years old)	0.65 [0.34–1.22]	0.64 [0.30–1.33]	0.23
Adult (18–70 years old)	1.00	1.00	
Child (<18 years old)	2.35 [0.56–16.01]	4.03 [0.51–89.68]	0.25
Relationship with patient			
Stranger	1.00	1.00	
Close	1.05 [0.49–2.21]	0.94 [0.37–2.33]	0.90

N = 188; 6 observations deleted due to missing data.
OR = unadjusted Odds Ratio; CI = 95% Confidence Interval; AOR = Adjusted Odds Ratio.

  [*] *p*-values refer to Adjusted Odds Ratios.

tense that call-takers chose when they ask callers to describe the emergency is relevant within the MPDS, but more generally for all English-speaking countries in which other protocols are used. Further studies on various languages could determine which tense is most successful in triggering a report from callers, depending on each language's tense system.

In this retrospective observational study, the effect of tense remained after accounting for potential confounders. Further research could assess the causal effect of a change of tense by means of a randomised controlled trial, as well as the effect of tone.

Our findings call for further work to identify other potentially modifiable aspects of the interactional dynamics (akin to Stokoe's "interactional nudges" [36]) between caller and call-taker during emergency ambulance dispatch. Further research could focus on many different aspects of emergency calls, such as the assessment of the patient's breathing and the delivery of instructions for cardio-pulmonary resuscitation (CPR), two aspects which are notoriously difficult to carry out over the telephone [4,12,37,38]. Taken all together, these findings about the linguistic and interactional structure of emergency calls could contribute to make a substantial difference for OHCA, the ultimate time-critical medical emergency [1,39,40].

Conclusion

Our results generate the hypothesis that a change of tense can impact how efficiently callers describe a time-critical emergency.

When call-takers ask callers to describe the emergency, our results indicate that they should do so by using the present perfect (*tell me exactly what's happened*) to increase the likelihood that callers respond with an informative and short report. A comprehensive understanding of the linguistic and interactional dynamics of emergency calls has the potential to improve dispatch performance for emergency services.

Conflict of interest declaration

Appendix A. Transcription conventions

CT	Call-taker
C	Caller
(.)	Very short pause
(..)	Short/medium pause
:	Lengthening
⌐¬	Overlap with following turn
∟⌐	Overlap with previous turn
↗	Rising tone
↘	Falling tone
.h, .hh	In-breath
h, hh	Out-breath
°word°	Lower volume, whispered segment
((SNIFF))	Non-linguistic sound or anonymised content

Appendix B. Definition of narrative components

Our definition of narrative structure is based on Labov and Waletzky's [31] analysis of oral narratives of personal experience, which can be divided into five sections: "orientation (scene-setting), complication (core sequence of events unfolding), evaluation (justifying the point of the narrative: how and why it is remarkable), resolution (what finally happened), and coda (the moral of the story, returning the perspective to the present)" as summarised in Richard and Rodríguez Louro (2016: 120) [41].

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