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Review

Speaking up to prevent harm: A systematic review of the safety voice literature

Mark C. Noort*, Tom W. Reader, Alex Gillespie

London School of Economics and Political Science, Department of Psychology and Behavioural Science, 3rd Floor Queens House, 55/56 Lincolns Inn Fields, London WC2A 3LJ, UK

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ABSTRACT

Safety voice is the act of speaking up about safety in order to prevent accidents and physical harm. It occurs across contexts (e.g., healthcare, aviation, construction, mountaineering, high-risk sports) and understanding the phenomenon enables interventions. Despite recent interest, however, it remains unclear how safety voice (i) differs conceptually from employee voice, (ii) is delineated across levels of analysis, and (iii) could be optimally investigated. Addressing this, we identified 48 articles, and integrated 256 safety voice antecedents, 7 pragmatics and 23 outcomes into an ecological framework. Overlap was found with employee voice concepts and methodologies, especially for the behavioural nature of speaking-up. Nonetheless, safety voice appeared unique in terms of the content of the raised message (e.g., limited to safety), the context and person speaking-up, identified antecedents (e.g., hazard-specific antecedents), and methodological challenges (e.g., operationalisation of victimhood). Our proposed safety voice framework provides a novel approach to safety voice that is ecological and indicates interventions for mitigating physical harm.

1. Introduction

Safety voice is the act of speaking up to prevent physical harm from hazardous situations (Bienefeld and Grote, 2012). Hazardous situations permeate organisations (e.g., dispensing medication, operating heavy goods equipment) and daily life (e.g., driving, high-risk sports; Fischer et al., 1991; Wilson, 1979), and raising safety concerns can identify and prevent potentially disastrous outcomes from these (e.g., medication error, crashes, drowning). Popular discourse frequently attributes the causes of mishaps to a lack of safety voice (BBC, 2015), and safety voice is repeatedly shown as an antecedent to avoiding harm (Turner et al., 2015).

The role of safety voice in accident prevention has led to considerable research interest, with observations, surveys, and interviews being used to investigate the antecedents, pragmatics, and consequences of raising safety concerns in various domains, and organisational environments in particular (Morrow et al., 2016; Okuyamaet al., 2014). However, it remains unclear (i) how or why safety voice is conceptually distinct from phenomena such as employee voice, (ii) how levels of analysis (e.g., individual, team, organisation) at which safety voice operates are delineated, or (iii) what the optimal methodological approach to studying safety voice is. We conduct a systematic review to assess the uniqueness of the safety voice concept, integrate the safety voice literature into a conceptual ecological framework (i.e., a model outlining antecedents, pragmatics and outcomes across levels of analysis), and consider the methodological approaches best suited to studying safety voice. Through exploring safety voice concepts and methodologies, we provide clarity on the conceptual nature of safety voice, its ecological nature and methodological challenges for research, and outline possible future directions.

1.1. Safety voice: The need for an improved conceptualisation

The concept of safety voice describes acts of communication aimed at preventing physical harm through communicating safety concerns to others. Various definitions of safety have been proposed. For example, Tucker et al. (2008) stated that safety voice: "(a) is communication motivated toward changing perceived unsafe working conditions that have implications for individual and organizational health, (b) can flow through formal and informal channels, and (c) can be directed toward numerous targets (e.g., supervisors/managers, coworkers, union officials, government officials)" (p. 320). Other characteristics of safety voice have been considered: for example, its constructive (Hu et al., 2015) and challenging nature (H. L. Johnson and Kimsey, 2012), or its occurrence in improving general safety (Jones et al., 2016) versus emergency situations (Schwappach and Gehring, 2014c).

* Corresponding author.
E-mail address: m.c.noort@lse.ac.uk (M.C. Noort).

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The interest in safety voice has generated considerable research, with two reviews addressing the antecedents and consequences of safety voice (Morrow et al., 2016; Okuyama et al., 2014). Conceptually, and in particular for healthcare workers, these reviews highlighted that (i) employees report a hesitancy for raising safety concerns, (ii) predictors are contextual (e.g., a scenario causing a motivation to speak up, leadership, work relations) and individual (e.g., felt responsibility, a cost-benefit analyses of effectiveness and psychological safety), and (iii) raising safety concerns can avoid physical harm (e.g., through error correction). Yet, the safety voice concept remains disintegrated and nascent, with three outstanding issues.

1.1.1. Clarifying the conceptual relationship between safety voice and employee voice

Research on safety voice draws from work in organisational behaviour on employee voice/silence, yet is distinguished through its focus on safety (Tucker et al., 2008). The concept of employee voice is used to study discretionary suggestions by employees that are intended to improve work-related issues (Morrison, 2014) such as smoother procedures, innovations or halt of organisational decline. The origins of employee voice are attributed to Hirschman (1970) who investigated how organisational stakeholders dissatisfied with organisational decline chose to exit a company, stay loyal or voice their concerns. Subsequent research conceptualised employee voice as the neglect of issues (Farrell, 1983) and a time-bound, observable, extra-role behaviour (Van Dyne and LePine, 1998), and used questionnaire scales to measure it (LePine and Van Dyne, 1998). Thus, research attempted to identify the antecedents to employee voice, conceptualise its processes (Milliken et al., 2003) and identify sub-types of voice (Liang et al., 2012; Wu Liu et al., 2010).

Employee voice and safety voice overlap conceptually because both refer to extra-role communicative acts to address perceived issues and change the status quo (Manapragada and Bruk-lee, 2016; Morrison, 2014). Thus, it is important to integrate these conceptualisations, whilst addressing the ways in which safety voice is distinct (Wilkinson et al., 2019).

First, the phenomenon of safety voice is broader in sampling (i.e., it goes beyond employees, for example to patients in hospitals, or passersby) and narrower in phenomenology (i.e., focusing on preventing harm). Unlike employee voice, raising safety concerns can be a legally required and protected activity (whistleblowing; Tucker et al., 2008). Yet, due to the social risks involved, engagement in safety voice can be highly challenging. For example, research in healthcare has long examined why clinicians are hesitant to report observing concerns about safety, and these have included cultures of blame (e.g., Waring, 2005), non-receptive colleagues (Jones et al., 2016), fear of negative repercussions (Manapragada and Bruk-lee, 2016), and, unlike employee voice, aspects of the hazard (e.g., speed of the incident, Schwappach and Gehring, 2014c).

Second, the consequences of an absence of safety voice can be severe and highly proximal, with consequences for self (e.g., personal harm) and others (e.g., organisational accidents). For example, in a decision-making analysis of the Challenger space shuttle disaster (Moorhead et al., 1991), self-censorship of supplier staff members was deemed an important factor leading to the eventual seven fatalities (i.e., after pressure from NASA, an earlier held safety concern was suppressed in the final recommendation for launch). Similarly, analysing communication in healthcare, Wei Liu et al. (2016) showed that raising safety concerns mitigated medication errors. Research on employee voice tends to focus on events with more individualised, and less severe, outcomes that carry a lesser moral obligation for raising issues. For example, a lack of employee voice can lead to unfavourable outcomes in terms of job satisfaction, turnover, citizenship behaviours or organisational performance (Bashshur and Oc, 2014).

Third, safety voice research is grounded within a distinct set of literatures to employee voice. For example, the safety culture and climate literatures (e.g., Gauld and Horsburgh, 2014), and research on human error and systems theory (Aydon et al., 2016; Barton and Sutcliffe, 2009). These fields describe how characteristics of social systems (or lack thereof) enable safety, with speaking-up on safety frequently being incorporated into measures of safety culture and climate (Reader et al., 2015; Sexton et al., 2006) and safety citizenship (e.g., “I make suggestions to management to improve the safety of the work environment”; Reader et al., 2016, p.9). Furthermore, due to its social nature, safety voice has been framed and investigated through research on interdisciplinary collaboration (e.g., P. Liu and Ma, 2016), crew resource management (e.g., Lyndon, 2008) and shared decision-making (e.g., Frosch et al., 2012). This has helped identify group and institutional antecedents to safety voice (e.g., different experience levels; Wei Liu et al., 2016).

Fourth, within safety-critical environments, extra-role behaviours can be empirically distinguished on whether they are safety- or organisation-specific. Voicing safety concerns is considered a safety citizenship behaviour (i.e., extra-role behaviours for managing risks; Didla et al., 2009), and this wider concept is shown to be distinct from organisational citizenship behaviours (Reader et al., 2016). Direct empirical tests comparing safety and employee voice remain absent, and are beyond the scope of this article, yet this suggests that within safety-critical contexts, the safety-related content of the communicated message may provide unique practical relevance beyond employee voice and a need to investigate the content of the message voiced (Morrison, 2011; Wilkinson et al., 2019).

Thus, in terms of conceptualising safety voice, a key observation emerges. Initially, safety voice appears to be a similar phenomenon to employee voice. It involves discretionary acts of communicating issues, to those with institutional power, in order to improve the status-quo. However, it also appears distinct, with relevance to those outside of an organisation (e.g., the public), different triggers to voice across levels of analysis (e.g., legal necessity, personality, observing hazards), unique consequences (e.g., personal harm, accidents), practical relevance within safety-critical organisations, and distinctive foundational literature. Therefore, it is not clear whether safety voice should be considered a subtype of employee voice phenomena, or a unique concept drawing on overlapping ideas and behaviours. This is important, but has not been directly addressed in reviews of the concept, with models of safety voice using models of employee voice to thematise research findings (Morrow et al., 2016). Yet, if safety voice is a sub-type of employee voice (Morrison, 2011), the need for a distinct literature is lessened with considerable scope for integration (Wilkinson et al., 2019), and the research findings (e.g., on voice antecedents) and methodologies for studying employee voice can be assumed to apply to safety voice. Alternatively, if safety voice is indeed an overlapping but highly distinct phenomenon, then the distinctive scope of this domain (e.g., outcomes), key research findings (e.g., different relationships amongst safety voice antecedents, pragmatics and outcomes), and methodological challenges (e.g., how to observe safety voice) need to be better articulated and presented.

1.1.2. Creating an ecological conceptualisation of safety voice

Safety voice is an ecological phenomenon. It is found to vary according to individual factors (Bienefeld and Grote, 2012), group (e.g., safety-specific transformational leadership; Conchie et al., 2012), institutions (e.g., hierarchical effects) and external environments (e.g., national culture; Malloy et al., 2009). This means that the manifestation of safety voice will vary according to the specific characteristics of a situation (individual, group, institutional, external), and corresponds to a systems approach to safety and ecological models of behaviour that specify levels of analysis (Bronfenbrenner, 1977; Erez and Gati, 2004; Leveson, 2002). It suggests that distinguishing the levels at which safety voice is analysed is important for illuminating relationships among safety voice antecedents, pragmatics and outcomes, and enabling targeted interventions (Leveson, 2002).

However, research has largely neglected conceptualising the ecological nature of safety voice, and as a consequence most scholars have not differentiated findings. Manapragada and Bruk-Lee (2016) distinguished relationship-, job-, climate- and issue-based motives for safety voice and others distinguished (work) environment antecedents (e.g., Aydon et al., 2016; Lindberg et al., 2013), but differentiation into levels of analysis is scarce. In their review of the literature, Morrow et al. (2016) identified eleven qualitative studies and synthesised these into four themes (i.e., hierarchies and power dynamics; perceptions of unsafe/ineffective open communication; expectations and socialisation; managerial influence), but did not offer an integrated conceptual model for relationships amongst safety voice variables, or an account of the ecological nature of safety voice. Similarly, Okuyama et al. (2014) review of 27 articles describing safety voice in healthcare identified the antecedents (e.g., motivation and clinical context, perceived safety of speaking up), pragmatics (e.g., tactics involved in speaking up), and outcomes (e.g., error correction) of safety voice. However, observations were not framed within a complete ecological conceptualisation; individual, team, and institutional factors were collapsed together, not delineated. For example, individual factors (e.g., 'roles as professionals') partly referred to social systems (i.e., organisations).

Thus, there is a need to better conceptualise the ecological nature of safety voice, and to consider research findings within this framework. Through doing this, we enable stronger interventions that can target variables across levels of analysis and reveal gaps in research. One approach would be to apply a previously established ecological model operating at varying levels of analysis to the safety voice literature, for example the hierarchical model of organisational behaviour (e.g., individual, group, organisation, external context) proposed by Erez and Gati (2004). They proposed that levels interact in top-down (e.g., organisational hierarchy enabling an individual sense of power) *and* bottom-up ways (e.g., individuals' personalities shaping teamwork), and due to this dynamic nature safety voice variables would interact and shape each other.

1.1.3. Optimising methodologies for investigating safety voice

Emulating the research tradition within fields such as safety culture and climate, safety voice studies have tended to utilise cross-sectional surveys (e.g., Barnett, 1992) and interviews (e.g., Aydon et al., 2016) to identify the organisational antecedents (e.g., the availability of time-outs, workload) or characteristics of those who voice safety concerns (e.g., job type, age, gender; Gauld and Horsburgh, 2014; McLaughlin et al., 2014; Nembhard et al., 2015). These approaches have addressed the short-lived nature of the act of raising a safety concern (i.e., it is contained to the moment of speaking up and difficult to encounter spontaneously) through retrospective reports by individuals who voiced or their supervisors.

Yet, the appropriateness of using surveys and interviews to investigate safety voice is uncertain. Methodologies have their strengths and weaknesses (e.g., surveys' low resource demands versus lack of depth), and the field of safety may be subject to mono-methodological bias, with surveys not yielding behavioural data, or causal understanding of its drivers and outcomes. Furthermore, biases may emerge due to the nature of safety voice. For example, if safety voice involves taking a social risk to avoid physical harm, anonymised surveys and interviews may be inflated because the moral obligation to appear as a voicer may be stronger than the social risk involved in providing data.

Alternative methodologies have been used, for example interventions (e.g., Habyarimana and Jack, 2011) and observations (Bienefeld and Grote, 2012), and qualitative research has attempted to understand the pragmatics of safety voice (i.e., how one uses language to voice) and strategies to best communicate safety (Bickhoff et al., 2016; Wei Liu et al., 2016; Lyndon, 2008). Yet, the suitability of these approaches remains unclear. Thus, there is a need to assess the variety of methods to identify optimal methodologies for investigating safety voice.

1.2. The current study

To establish the relevance of the concept of safety voice it is important to investigate whether safety voice is unique in terms of its concepts, ecological nature and methodological challenges. These issues can only be addressed through systematically reviewing and synthesising the safety voice literature. Previous analyses of this literature have not addressed these concerns, and have focused only on qualitative studies (Morrow et al., 2016), or healthcare professionals (Okuyama et al., 2014). The systematic review is conceptual in nature – empirical tests of the predictive validity of safety voice in comparison to employee voice are beyond our scope – and we address three issues.

First, we address the conceptualisation of safety voice, and its overlap with employee voice. We synthesise the concepts and data from the safety voice literature into a unified framework that provides conceptual clarity. We do this in order to illuminate the conceptual uniqueness of safety voice from employee voice and reflect on its congruency with Morrison's (2011) model of employee voice, which is the only model that explicitly lists antecedents, voice and outcomes. Thus, we aim to identify the nature and usefulness of the safety voice concept, and ask: *1) what definitions, conceptualisations and theoretical backgrounds characterise safety voice?*

Second, we establish an ecological approach to conceptualising safety voice. To date, a lack of an ecological framework of safety voice has driven scholars towards limited coverage of the phenomenon, with observations being generalised or specific to narrow situations. Through reviewing the literature, the various individual, group, institutional and external variables that influence safety voice can be identified and synthesised, with an over-arching conceptual model being produced. We thus aim to evaluate the empirical evidence on safety voice to date, propose an ecological framework for future research on safety voice, and ask: *2) what is the ecological nature of safety voice in terms of inhibiting (promoting) relationships between safety voice and antecedents, pragmatics, and outcomes across levels of analysis?*

Third, we evaluate methodological approaches to investigating safety voice. Safety voice research faces unique challenges in researching a phenomenon for which harm can be immediate (i.e., imminent harm can be prevented) and proximal (i.e., it can affect victims' bodies), the social desirability of speaking up is diffuse (i.e., it is a risk and moral obligation), and its behavioural nature may obscure post-hoc methodologies (i.e., self-reports may be inaccurate). However, the effectiveness of different methodologies has not been reviewed and challenges to researching safety voice remain unaddressed. Accordingly, we ask: *3) which methodologies have been used for researching safety voice, how suitable are they, and what methodological challenges remain?*

2. Methods

2.1. Search strategy

This review followed PRISMA guidelines for systematic reviews (Liberati et al., 2009) and applications of these (Reader et al., 2014). The search strategy for this study was pre-registered on PROSPERO (Noort et al., 2017), and is presented in Fig. 1. The inclusion/exclusion criteria are outlined in Table 1.

Identification. English peer-reviewed articles were identified through using the PubMED and EBSCOhost search engines. A preliminary search revealed that relevant articles included 'safety' and a variation of 'voice', 'speaking up/out' or 'silence', and articles on diverse subjects (e.g., prosocial, citizenship behaviours). However, safety voice is difficult to disentangle from scales containing items on safety voice (e.g., 'I am willing to warn other coworkers about working unsafely') and other behaviours (e.g., "I am willing to pick up work-place litter that I did not cause myself"; Geller et al., 1996). Furthermore, including '*communicat*' provided an unwieldy number of hits (± 7 times more), and

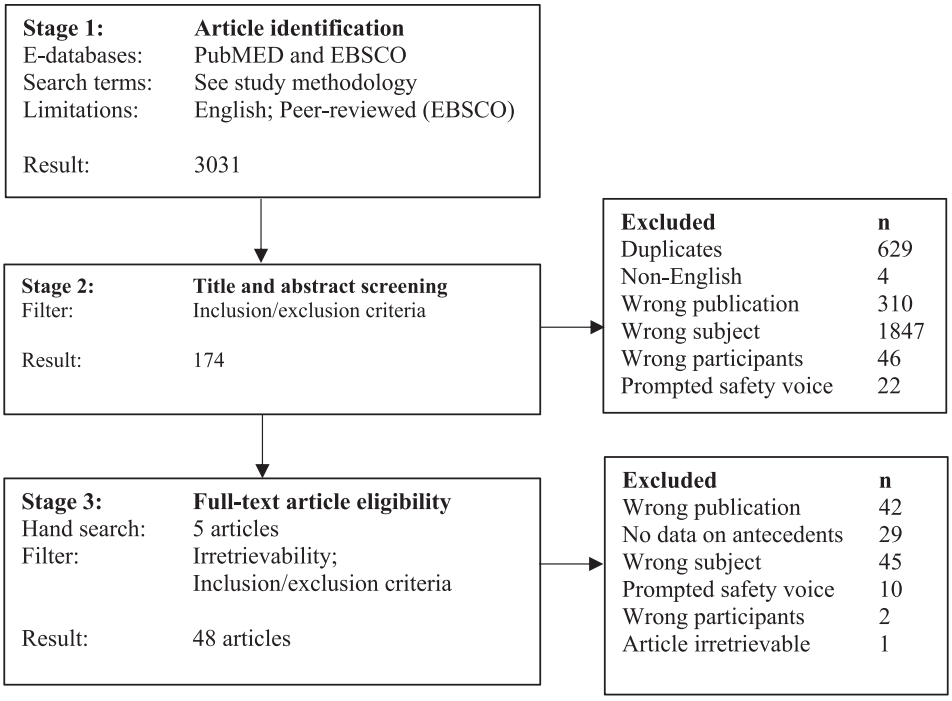

Fig. 1. Flow diagram of the systematic literature review on safety voice.

Table 1
Inclusion and exclusion criteria.

Domain	Include	Exclude
Publication	• Peer-reviewed articles	• Duplicates • Book/film/literature reviews • Periodicals • Editorials • Dissertations • On-going, unpublished trials • Errata (unless referring to extracted information) • Conference proceedings (e.g., keynotes, panel discussions)
Language	• English	• All other languages
Subject	• Raising safety concerns to another person (behaviour)	• Voice technology (e.g., VoIP) • Language skills • Physiological voice • Technology-mediated communication • Medical diseases • Primarily about ethics • Primarily about law • Intimate relationships • Drugs or therapies (not raising concerns)
Method	• Empirical, primary study • Quantitative • Qualitative	• No original data • People speak up when prompted (e.g., focus group) • Authors advocate for a group • Calls to speak up about an issue
Participants	• Behavioural • From/to all staff roles/ hierarchies	• Non-adult participants • Mental health patients • Unions or organisations advocating an issue
Predictors	• All predictors	• No predictors discussed
Outcomes	• All outcomes	• N/A

'organi?ation*' specified an inappropriate a-priori contextual bound. Hence, to provide hits specifically related to safety voice (e.g., safety-related silence) the search term "(*safe* AND silenc*) OR (*safe* AND speak*) OR (*safe* AND voic*)" was used to search in titles and abstracts in the following databases: Anthropology plus, Business source complete, CINAHL Plus with full text, Communication and mass media complete, Criminal justice abstracts with full text, History of science, technology, medicine, International political science abstracts, MEDLINE, Peace research abstracts, PsycArticles, PsycINFO, SocINDEX with full text.

Irrelevant articles during the preliminary search related to physiological voice (e.g., pitch), voice technology (e.g., Voice over Internet Protocol), language skills (e.g., English-speaking), and wrong participants (e.g., children, mental health patients, intimate relationships). Therefore, in the final search hits were excluded based on the following search term: "Technolog* OR VoIP OR Computer? OR PC OR Pitch OR Intonation OR Anatomy OR vocal OR Child* OR "Mental health" OR Contraception OR HIV OR molecular OR therapy OR airway OR syndrome OR "Language skill?" OR "-speaking". A detailed search history is published online (see supplementary material).

Screening and Eligibility. After the removal of duplicates, the title and abstracts of identified articles were screened based on the inclusion criteria (see Table 1). Finally, full-text articles were retrieved and checked for their eligibility. Inter-coder reliability was established through double coding 15% of the 3031 hits by a research assistant trained on applying the inclusion criteria. Gwet's AC1 was calculated as it is a robust measure for datasets with a high prevalence of one category (e.g., excluded articles; Wongpakaran et al., 2013). Very good agreement was found, indicating a reliable application of the inclusion criteria, $AC1 = 0.92$ (95CI: 0.89–0.95), $p < .001$.

2.2. Data extraction and analysis[1]

2.2.1. Descriptive data

Data extraction. (i) author(s), (ii) year of publication, (iii) journal, (iv) country, (v) industry or context, (vi) number of studies in a publication, (vii) amount of safety voice. Quality indicators (Cochrane,

[1] Extracted data (and definitions of data extraction codes) are available as supplementary material.

open science, inter-coder reliability): (i) comparability of study groups, (ii) appropriateness of randomisation, (iii) whether randomisation was performed blindly, (iv) sample representativeness (i.e., response rate > 40%), (v) appropriateness of exclusions, (vi) compliance with ethical standards, (vii) appropriateness of treatment of missing data, (viii) achievement of inter-coder reliability, and (ix) open science achievements[2]. Cochrane quality indicators are developed for randomised control trials (Higgins et al., 2011). Hence it was recorded when quality indicators were not applicable.

Data analysis. Trends on publication history and outlets, country, industry distribution, and quality indicators. Calculations for the amount of safety voice (weighted by study size, limited to pre-intervention amounts, aggregated across sub-groups) reported in articles. Likert scale scores were converted to percentages (e.g., 4.5 on 5-point Likert scale with 5 indicating safety voice is calculated as (4.5–1)/(5–1) = 87.5%).

2.2.2. Concept of safety voice

Data extraction. (i) Definition of safety voice, (ii) theoretical background. Theoretical backgrounds (i.e., theories or models) were deducted from the argument and cited literature if none was explicitly stated.

Data analysis. Trends on the theoretical background of studies, and synthesis of definitions of safety voice through coding and thematically grouping key concepts of extracted definitions (e.g., 'speaking up about safety' was coded as: 'safety-related issues' and 'speaking up').

2.2.3. The ecological nature of safety voice

Data extraction. (i) Individual-level antecedents, (ii) group-level antecedents, (iii) institutional-level antecedents, (iv) hazard-specific antecedents, (v) other antecedents, (vi) safety voice pragmatics, (vii) safety voice outcomes, (viii) direction of relationship (i.e., promoting/inhibiting), (ix) voice variable statistics. Variables were only used for the synthesis when a significant relationship (e.g., thematic, correlational, regression) was suggested in the study's results section.

Data analysis. Qualitative synthesis of the evidence on safety voice through coding and thematically grouping antecedents, pragmatics and outcomes into first and second order themes (e.g., 'fear of retaliation' and 'sense of safety' were coded as 'fear for consequences' and the higher order theme 'perceived cost of voice'), and according to level of analysis. After bottom-up synthesis, we adopted labels from Morrison's model of employee voice (Morrison, 2011) when the constructs overlapped. All grouped variables were recoded to reflect the same relationship to safety voice (i.e., promoting/inhibiting).

An ecological framework is proposed through (i) providing a consistent terminology for similar but differently named antecedents and outcomes (Dixon-Woods et al., 2006; Readeret al., 2014), (ii) thematically integrating related antecedents for the individual, group, institutional, external and hazard-specific levels, (iii) thematically integrating related outcomes, and (iv) identifying promoting or inhibiting relationships to safety voice.

2.2.4. Methodological data

Data extraction. (i) Operationalisations, (ii) quantitative/qualitative methods, (iii) methodology, (iv) unit of analysis, (v) independence of dataset, (vi) manipulations, (vii) interventions, (viii) high-level participant information, (ix) number of participants, (x) number of outliers deleted.

Data analysis. Trends on the use of methods and operationalisations through coding and grouping these based on similarity (e.g., structured and open-ended interviews were coded as 'interviews').

[2] We employed a broad definition of open science where open science was coded when follow-up research was supported (e.g., through providing materials, data or inviting opposing views). Whether publications were open access was not recorded because this is often achieved through paying a fee.

3. Results

3.1. Search results

A total of 48 articles met the inclusion criteria (see Table 1), including five articles identified through hand-search. The articles included 50 studies, with one article including three studies (Manapragada and Bruk-lee, 2016). The extent that people raised safety concerns was provided by 24 studies ($m_{weighted}$ = 44%; SD = 4%), and an effect size could be extracted (or calculated) from 15 quantitative studies. However, 62 effect sizes were dispersed over 42 distinct variables (i.e., many variables had only up to two effect sizes). Therefore, at this stage of the literature, the planned *meta*-analysis would not provide additional information beyond repeating authors cited. The amount of safety voice was not associated with the number of extracted variables, or context of research (i.e., healthcare or USA versus other contexts).

3.2. Description of the safety voice literature

Interest in safety voice emerged recently (i.e., 45 of the 48 articles were published in the last decade), and publication outlets were diverse. Publications were spread over 37 journals, and the outlet containing most publications, AORN Journal, had only three publications.

Study contexts were heavily biased towards the United States (i.e., 50% of the studies). Three studies had an international sample (Anicich et al., 2015; Bienefeld and Grote, 2012; Malloy et al., 2009). Similarly, indicating the need for a context-agnostic framework, an industry-bias exists towards research in healthcare (n = 41). Further research was conducted in transport (Habyarimana and Jack, 2011; Tucker et al., 2008), aviation (Bienefeld and Grote, 2012), wildland firefighting (Barton and Sutcliffe, 2009), secondary education (Turner et al., 2015), oil and gas (Conchie et al., 2012) or across industries (n = 2; Barnett, 1992; Manapragada and Bruk-lee, 2016 (Study 1)). Furthermore, despite inclusive inclusion criteria for contexts, no studies were found outside of institutions with, arguably, mountaineering groups (Anicich et al., 2015) being the least institutional in nature. These biases are important: as a proportion of extracted variables (i.e., antecedents, pragmatics, outcomes), USA-based studies have identified fewer group-based antecedents (i.e., 23% vs 31% for other countries), and healthcare-based studies identify greater organisational antecedents (24% vs 8% for other industries) but less individual antecedents (32% vs 42%). This suggests context is important for researching and contextualising safety voice, and the literature might address whether unique antecedents exist across contexts (e.g., daily life).

In terms of publication quality (i.e., Cochrane, open science, inter-coder reliability), studies varied in applicable quality indicators (M = 5.86; SD = 1.41) of which they met 45% (SD = 20%). Most studies reported obtaining ethical approval or following industry-standard procedures (n = 32; e.g., obtaining informed consent). However, eighteen studies did not report sufficient information to determine ethical standards. The weakest quality of the safety voice literature is its treatment of missing data. That is, most studies did not report procedures (n = 24) or used list-wise deletion rather than data imputation (n = 4). Finally, only fifteen studies promoted open science: thirteen studies provided study materials and/or data (i.e., online, printed, or through the author), one had an invited commentary (Barzallo Salazar et al., 2014) and another a large online appendix on the study methodology (Anicich et al., 2015). Six open-science articles (38% of all articles in this period) were published before the recent growth in open science (around the year 2013 when the Centre for Open Science was founded); nine (28%) after 2013. This indicates a need to publish higher quality articles in terms of clarifying ethics, improving the treatment of missing data, and promoting open science. Descriptive information regarding the studies is presented in Table 2.

Table 2
Descriptive information of articles included in the review.

Authors	Journal	Study	Country	Setting	Methods	Out.	Prag.	Antecedents				
								Haz.	Ind.	Gr.	Org.	Ext.
Anicich, et al. (2015)	PNAS	1	27 countries	Mountaineering	Vignettes	1	0	0	0	1	0	0
Aubin and King (2015)	Journal of Interprofessional Care	1	Canada	Healthcare (education)	Experiment	0	0	0	2	1	1	0
Aydon et al. (2016)	Journal of Clinical Nursing	1	Australia	Healthcare (neonatal care)	Interviews	0	0	0	2	5	4	0
Barnett (1992)	Journal of Business Ethics	1	USA	Cross-industry	Survey	0	0	0	0	0	2	0
Barton and Sutcliffe, 2009	Human Relations	1	USA	Wildland Firefighting	Interviews	2	0	0	2	4	0	0
Barzallo Salazar et al. (2014)	Journal of the American College of Surgeons	1	USA	Healthcare (education)	Experiment	1	0	0	0	1	0	0
Bickhoff et al. (2016)	Nurse education today	1	Australia	Healthcare (education)	Interviews	0	1	0	0	0	0	0
Bienefeld and Grote (2012)	Aviation Psychology and Applied Human Factors	1	Europe	Aviation (air crew)	Observation, survey	0	0	1	4	3	2	0
Blanco et al. (2009)	AORN Journal	1	USA	Healthcare (surgery)	Survey	1	0	0	0	0	0	0
Conchie et al. (2012)	Journal of Occupational Health Psychology	1	UK	Oil & Gas	Survey	0	0	0	3	1	0	0
Davis et al. (2013)	Journal of Evaluation in Clinical Practice	1	UK	Healthcare (surgery)	Focus groups	0	0	0	0	0	1	0
Delisle et al. (2016)	Journal of Interprofessional Care	1	Canada	Healthcare	Survey	0	0	0	0	0	0	0
Frosch et al. (2012)	Health Affairs	1	USA	Healthcare (primary care)	Focus groups	0	0	0	1	3	3	0
Gauld and Horsburgh (2014)	Australian Health Review	1	New Zealand	Healthcare	Survey	0	0	0	2	0	1	0
Gkorezis et al. (2016)	Journal of advanced nursing	1	Cyprus	Healthcare (nursing)	Survey	0	0	0	4	1	0	0
Gurung et al. (2017)	BMC health services research	1	Nepal	Healthcare	Interviews	0	0	1	2	2	4	0
Habyarimana and Jack (2011)	Journal of Public Economics	1	Kenia	Transport (long-distance road transportation)	Intervention	2	0	0	0	1	0	0
Hanson (2017)	Journal of infusion nursing	1	USA	Healthcare (intensive care)	Survey, quasi-experiment	0	0	0	0	0	0	0
Hemingway et al (2015)	AORN Journal	1	USA	Healthcare	Survey	0	0	0	0	0	0	2
Henkin et al. (2016)	Journal of multidisciplinary healthcare	1	USA	Healthcare (general medicine)	Intervention, survey	0	0	0	1	0	0	0
Hovey et al. (2011)	Qualitative health research	1	USA	Healthcare	Interviews	1	0	0	1	2	1	0
Howard et al. (2013)	Journal of patient safety	1	Australia	Healthcare (acute care)	Interviews	0	0	0	2	0	0	0
Hu et al. (2015)	Journal of the American College of Surgeons	1	USA	Healthcare (surgery, anaesthesiology, nursing)	Observation	0	0	0	0	1	0	0
Jackson et al. (2010)	Journal of Advanced Nursing	1	Australia	Healthcare (nursing)	Interviews	5	0	0	3	0	2	0
Jacobsson et al. (2012)	Scandinavian journal of trauma, resuscitation and emergency medicine	1	Sweden	Healthcare (trauma)	Observations	0	0	0	0	2	0	0
Johnson and Kimsey(2012)	AORN Journal	1	USA	Healthcare (anaesthesia, surgery, obstetrics, gynaecology, perioperative services)	Survey	1	0	0	0	0	0	0
Johnson et al. (2006)	Archives of dermatology	1	USA	Healthcare (cross-sectional)	Survey	0	0	0	2	0	0	0
Jones et al. (2016)	International Journal of Nursing Studies	1	England, Wales (UK)	Healthcare (executive boards)	Interviews	0	0	0	0	6	1	0
Kulig and Blanchard (2016)	Journal of graduate medical education	1	USA	Healthcare (anaesthesia)	Intervention	1	0	0	9	1	0	0
Lindberg et al. (2013)	International journal of qualitative studies on health and well-being	1	Sweden	Healthcare (elderly care nurses)	Interviews	0	0	1	2	8	5	0
Liu et al. (2016)	Journal of clinical nursing	1	Australia	Healthcare (acute care)	Critical ethnography	0	4	0	0	3	1	0
Lyndon (2008)	Journal of Obstetric, Gynecologic, and Neonatal Nursing	1	USA	Healthcare (perinatal care)	Interviews, observation	2	2	1	4	3	4	0
Malloy et al. (2009)	Nursing Ethics	1	Canada, Ireland, Australia, Korea	Healthcare (nursing)	Focus groups	0	0	0	1	0	1	1
Malvey et al. (2013)	Journal of Healthcare Management	1	USA	Healthcare	Survey	0	0	2	2	1	2	0
Manapragada and Bruk-lee (2016)	Accident Analysis and Prevention	1	USA	Safety-critical organisations	Focus groups, interviews	0	0	1	1	2	2	0
		2	USA	Healthcare (Nursing)	Survey	0	0	1	0	1	2	0
		3	USA	Healthcare (Nursing)	Survey	1	0	1	3	1	3	0
Manias (2015)	Health Expectations	1	Australia	Healthcare (surgery, medical teaching)	Interviews	1	0	1	5	3	0	0
Maxfield et al. (2013)	American Journal of Obstetrics & Gynaecology	1	USA	Healthcare (labour-and-delivery)	Survey	0	0	0	2	2	0	0
McLaughlin et al. (2014)	World neurosurgery	1	USA	Healthcare (surgery)	Survey	0	0	0	0	0	2	0
Nembhard et al. (2015a)	Health Care Management Review	1	USA	Healthcare (primary care)	Survey	2	0	0	0	0	1	0
Nembhard et al. (2015a)	Health Care Management Review	1	USA	Healthcare	Interviews	0	0	0	8	0	7	0
Noland and Carmack (2015)	Qualitative health research	1	USA	Healthcare (nursing education)	Interviews	0	0	2	3	1	1	0

(*continued on next page*)

Table 2 (*continued*)

Authors	Journal	Study	Country	Setting	Methods	Out.	Prag.	Antecedents				
								Haz.	Ind.	Gr.	Org.	Ext.
Phelps and Reed (2016)	Canadian Journal of Infection Control	1	USA	Healthcare	Focus groups	0	0	0	6	4	1	0
Schwappach and Gehring (2014b)	PLOS ONE	1	Switzerland	Healthcare (oncology)	Vignette study, survey	0	0	2	6	5	4	0
Schwappach and Gehring (2014c)	BMC Health Services Research	1	Switzerland	Healthcare (Oncology)	Interviews	0	0	2	2	0	3	0
Schwappach and Gehring (2014a)	BMJ Open	1	Switzerland	Healthcare (oncology)	Interviews	0	0	1	0	4	1	0
Seiden et al. (2006)	Quality & Safety in Health Care	1	USA	Healthcare (education)	Case study	1	0	0	1	4	1	0
Tucker et al. (2008)	Journal of Occupational Health Psychology	1	UK	Transport (bus drivers)	Survey	0	0	0	5	1	1	0
Turner et al. (2015)	Journal of Safety Research	1	Canada	Education (high schools)	Survey	1	0	0	1	0	0	0

Abbreviations: Out.: Outcome; Prag.: Pragmatics; Haz.: Hazard; Ind.: Individual; Gr.: Group; Org.: Organisational; Ext.: External context.

3.3. The concept of safety voice

3.3.1. Definitions

Thirty-two studies provided a definition of safety voice, and 110 concepts were identified across the definitions (M = 3.4; SD = 1.6). Some definitions were shorter (e.g., “speaking up about safety issues”; Manapragada and Bruk-lee, 2016) than others (e.g., the definition stated above by Tucker et al., 2008). Definitions of safety voice emphasised communication (n = 30), unsafe situations (n = 36), discretion (n = 2) improvement-focus (n = 12), actors (e.g., from lower ranked staff; addressed to superiors; n = 11), and that it originates with a perception of a situation (n = 4). Five concepts were very generic (i.e., that safety voice is a motivation, willingness or ability), seven referred to variable aspects of delivering safety voice (e.g., assertiveness, persistence), and five other concepts put a stringent theoretical bound on the context of safety voice (e.g., work-related issues; Nembhard et al., 2015). Synthesising these concepts, safety voice may thus be defined as: explicit communication that is (1) discretionary, (2) aimed at improving a perceived unsafe situation, and (3) addressed to others of equal or senior status.

3.3.2. Theoretical backgrounds

Forty-eight studies referred to a total of 79 theoretical paradigms (M = 1.58; SD = 0.91). Most prevalent were references to safety (n = 17; e.g., patient safety, safety culture, high reliability organisations), voice (n = 16; e.g., employee voice, speaking-up decisions, patient complaints), and working in teams (n = 17; e.g., leadership, organisational culture, CRM, workplace ostracism). The remaining paradigms referred to (i) diverse theoretical or pragmatic models (n = 15; e.g., social exchange theory, social influence, social defence theory, moral courage, national cultural values, black swan theory), (ii) patients (n = 5; e.g., patient advocacy), (iii) broad areas of interest (n = 6; e.g., attitudes, communication, quality improvement), or (iv) methodology-informed paradigms (n = 2; e.g., narrative standpoint, life-world phenomenology). This highlights that the literature on safety voice is theoretically disintegrated, and that it requires (i) a unified theoretical paradigm, and (ii) a clarification of overlaps and contrasts between different theoretical accounts.

3.4. The ecological nature of safety voice

The 50 studies described 256 antecedents to safety voice. These were delineated into levels of analysis as individual (n = 94; m = 1.84, SD = 2.18), group (n = 78, m = 1.56, SD = 1.86), institution (n = 64, m = 1.28, SD = 1.59), or external context (n = 3, m = 0.06, SD = 0.31). Seventeen antecedents (m = 0.34, SD = 0.63) were hazard-specific. This highlights that an ecological safety voice framework needs to incorporate properties of hazards to account for whether people voice their safety concerns. Less research investigated the pragmatics of the safety voice act (i.e., 3 studies, n = 7, m = 0.14, SD = 0.64) or outcomes (i.e., 15 studies, n = 23, m = 0.45, SD = 0.91). To provide a consistent terminology, the 256 antecedents, 7 pragmatics and 23 outcomes were collapsed based on resemblance within their level of analysis. This left 65 first-order antecedents (e.g., impact of harm, likelihood of harm) and 31 s-order antecedents (e.g., risk). Four types of safety voice outcomes were identified (i.e., negative experiences, reduced physical harm, action-driven communication, organisational performance). Through summarising findings, this demonstrates that safety voice has been mostly conceptualised in terms of antecedents (predominantly individual), and in particular that the field has researched the phenomenon as an ecological phenomenon. All antecedents, pragmatics and outcomes of safety voice across levels of analysis, and a conceptual comparison against Morrison’s (2011) model for employee voice, are presented in Table 3.

Table 3
The Safety Voice framework.

Hazard		+	−	n	Individual		+	−	n	Group		+	−	n	Institution		+	−	n	External context		+	−	n
1. Antecedents																								
Risk	High impact of harm	7		7	Demographics*	Older age	5	1	6	Norms	Unfavourable norms		5	5	Structures*	Larger size	1		1	National culture	Confucian		1	1
	High likelihood of harm	2		2		Female gender	4		4	Access	Legitimated in concerns	4		4		Segregated organisation		2	2	Outside interest	Media coverage	1		1
Speed	High speed		2	2		Higher SES	1		1		Ostracism	1	2	3		Group membership	n/a		7	Regulation	National guidelines	1		1
Awareness	Hazard noticed	2		2		Longer tenure and experience	3		3		Territorial colleagues		1	1		Hierarchy		8	8					
Information	Unambiguous situation	1		1	Perceived cost of voice*	Fear for consequences	2	11	13	Situational presence	Bystanders		2	2		Enabling structures/ resources	6		6					
	Involves personal information		1	1		Need to protect reputation		7	7		Self	1		1		Lack of open communication channels		3	3					
Controllability	Within control		1	1		Trusting others	4		4	(Leadership) Openness*	Receptive others	12		12	Culture*	Unfavourable culture		9	9					
Trade-offs	No conflicting motives		1	1		Favourable previous experiences	5		5		Invited or encouraged	9		9		Support	5		5					
					Personality*	Openness to experience	1		1	Relationship concerns	Good relationship with receiver*	7		7	Information	Legal advice against voice		1	1					
						Conscientiousness	1		1		Fragile relationships*		8	8		Availability of information	3		3					
						Extraversion	1		1		Safety voice affects others		2	2	Work configuration	High workload	1	14	15					
						Agreeableness	1		1	Hierarchy and leaders' actions*	Leadership style: consistent and transformational	3		3		Classroom-reality mismatch		1	1					
					Motivation*	To protect others	3		3							Busy work environment	1	2	3					
						Willingness to voice	3		3		Group hierarchy		7	7										
						Felt Responsibility	7		7		Difficulties due to authority		3	3										
					Position and status (power)*	Seniority	6		6	Shared safety knowledge	Other's are responsible/ know		3	3										
					Safety knowledge	Subject expertise	9	1	10		Others are fallible	4		4										
						Intuition to speak up	1		1		Shared understanding*	2		2										
					Perceived efficacy*	Ability to speak up	6		6	Opportunities	Learning opportunities	1		1										
						Self-confidence	5		5	Receiver type*	Community members	1		1										
					Perceived opportunity*	Sense of futility		5	5															
					Identification	With the organisation	1		1															

(*continued on next page*)

Table 3 (*continued*)

Hazard	+	–	n	Individual		+	–	n	Group		+	–	n	Institution		+	–	n	External context		+	–	n
2. Safety voice pragmatics				Language use*	Redefine issue			1															
					Work the hierarchy			1															
					Politeness			1															
					Increment urgency			1															
					Frame as support			1															
					Mirror receiver's language		2																
3. Outcomes																							
Physical harm*		12	12	Negative experiences*	Negative responses*		3	3	Action-driven communication*			3	3	Performance*			3	1	4				
					Sense of failure*		1	1															

+ Promoting/promoted by Safety Voice; - Inhibiting/inhibited by Safety Voice.
Note: where appropriate, extracted antecedents were recoded to provide a uniform polarity (e.g., all age antecedents were recoded towards indicating high age).
* Overlaps with Morrison's (2011) model for Employee Voice.

3.5. Methodological challenges

In terms of datasets, 39 studies had an independent dataset. Nine studies were part of a larger project, and two included reinvestigated data (Schwappach and Gehring, 2014a, 2014b). A total of at least 52,948 participants took part across the studies (M = 1177; SD = 3490; median = 135). The exact number of participants could not be determined for four studies (Hanson, 2017; Henkin et al., 2016; Phelps and Reed, 2016; Seiden et al., 2006), and twelve studies removed data (e.g., attrition, partial data).

Studies were qualitative (n = 23), quantitative (n = 22), or mixed-method (n = 5). Methodologies included surveys (n = 17), interviews (n = 12), focus groups (n = 4), field or lab experiments (n = 2), vignette studies (n = 2), video observations (n = 2), case studies (n = 1), and combinations of these (n = 8). Quasi-experimental methods for studying safety voice were limited (n = 1; Delisle et al., 2016), and few studies manipulated safety voice (n = 5, i.e., 2 through leader behaviours, 2 vignettes, 1 intervention timing) or tested safety voice interventions (n = 7, i.e., 4 training programs, 3 changes to the environment).

Safety voice variables (i.e., antecedents, pragmatics, outcomes) across levels of analysis were identified through quantitative (n = 67) and qualitative methods (n = 183), but qualitative studies identified relatively more group-based antecedents (32% vs 22% of all identified variables) and fewer outcomes (7% vs 15%).

To elicit data on safety voice, 32 studies used a single operationalisation of safety voice and eighteen studies used two (e.g., latent themes and scales). Most studies relied on safety voice as identified through latent themes (n = 28) or scales (i.e., target at individuals, n = 16, groups, n = 3, or institutions, n = 2).

Situational realism was approached through episode-recall (n = 11), vignettes (n = 2), or through in-situ observations (n = 5; e.g., observation or text analysis of transcribed conversations). Finally, only seventeen studies explicitly operationalised the victim in safety voice (whether self or other). Post-hoc reports were a dominant method to elicit data from voicing individuals (n = 40) or their seniors (n = 4). The use of external sources (e.g., databases, behavioural observation, insurance claims) was rare (n = 6).

Together, this indicates that 38 safety voice studies (76%) base findings on associations (i.e., correlations or themes). Research using broad-ranging methodologies has identified numerous variables and it seems appropriate to engage in a new phase of experimental research that can support the development and assessment of interventions in-situ. Furthermore, a need exists for improving safety voice operationalisations through (i) relying less on post-hoc reports that might bias results, (ii) disentangling victim-hood from voice, and (iii) increasing the realism of safety voice scenarios.

4. Discussion

This study systematically reviewed the safety voice literature, which consisted of 48 articles, most of which have been undertaken in healthcare and the US. In comparison to the safety voice model of Okuyama et al. (2014) our framework provides a more comprehensive overview (i.e., 65 versus 19 antecedents; 6 versus 3 pragmatics; 4 versus 2 outcomes) across clearly delineated levels of analysis. Three questions were addressed, and we revealed the state of the safety voice concept (i.e., grounded in diverse theories, definitions and conceptualisations), its ecological nature (i.e., spread across hazard, individual, group, institutional and external levels of analysis) and methodological challenges (i.e., high rate of research using report-based methods and contexts of the USA, healthcare). We revealed for the first time the safety voice outcomes, pragmatics and antecedents that inhibit (or promote) safety voice at Erez and Gati's (2004) levels of analysis for the individual, group, institutional and external context.

These findings have challenges and implications for safety voice, and we expanded upon these in the following sections.

4.1. The conceptual uniqueness of safety voice

Our systematic review revealed that safety voice had important conceptual overlaps with employee voice, yet also unique aspects that only warrant partial conceptual integration.

Behaviourally, safety voice appeared similar to employee voice. That is, safety voice concepts and definitions, like employee voice, described a verbal behaviour in which people communicate a concern to others (e.g., colleagues) to change a perceived situation, with a similar propensity (i.e., discrete, constructive, proactive), and grounded in communication and teamwork concepts (Morrison, 2011). Furthermore, whilst future work may uncover this, we did not identify studies describing unique variables for social risk, moral obligation or proximity of outcomes. This suggests that safety voice and employee voice may be difficult to distinguish in practice. For example, within safety-critical environments, concerns regarding the lack of protective equipment during a procedure can involve a safety issue (e.g., the new procedure can cause harm), a work-related issue (e.g., leadership does not comply with its responsibility to provide protective equipment), or bullying (e.g., being forced to work under lower standards than colleagues). This overlap highlights the potential for integrating behavioural concepts on speaking-up (Wilkinson et al., 2019), and a need for research to investigate the extent of empirical overlap in practice. We did not present evidence for this, and we anticipate future empirical investigations will prove fruitful.

However, safety voice appeared unique in terms of the content of the raised message, the context and person speaking-up, and identified antecedents. That is, because safety voice involves raising a safety concern in response to a perceived hazard it appears closer to prohibitive (i.e., concerns about practices that may harm organisations) than promotive employee voice (Liang et al., 2012). This is important because it suggests safety voice's scope may be limited to prohibitive messages (i.e., preventing harmful outcomes), and the safety content may provide a unique type of message and voice behaviour (Morrison, 2011). The issue of risk perception appears important for distinguishing safety voice: the need for safety voice hinges on the perception of a safety problem, and the recognition that it requires addressing. We agree with Morrison and colleagues (Morrison, 2011; Wilkinson et al., 2019) that voice research (in the broadest sense) should emphasise the content of the communicated messages, whilst continually evaluating potential for integration across voice types.

Furthermore, safety voice extends beyond organisational environments. Safety concerns are raised by other persons than employees (e.g., patients, family members, friends, bystanders; Hu et al., 2015), and beyond organisational contexts (e.g., in public, during sports activities; Anicich et al., 2015). Part of the unique value of safety voice thus resides in the broader context of hazardous situations and future research should explore hazardous scenarios outside of organisational environments.

Finally, in comparison to Morrison's model for employee voice (Morrison, 2011), unique antecedents exist for employee voice (e.g., job attitudes, learning, decision-making, group harmony) and safety voice (i.e., safety knowledge, norms, shared safety knowledge, information, work configuration, national culture, outside interest, regulation), with hazard-related antecedents revealing the unique scope of safety voice (see Table 3). Arguably, this reveals a difference in the fields' aims and scopes, and future research may identify further overlaps in antecedents.

4.2. Assumptions in researching safety voice

At least three distinctive assumptions appear to shape the safety voice literature in terms of theory and methods. These relate to the social nature of processes involved in safety voice, the cost and benefits of safety voice outcomes and the research context.

First, meaning is attributed to absences, and this implies that safety voice is a process of social construction. That is, silence (i.e., the absence of voice), and in particular safety (i.e., the absence of harm), are considered to constitute relevant concepts with real implications. This is important because things that have *not* occurred are difficult to assess, and manage, without invoking factors that precede, replace or follow from the absence, and it is difficult to understand safety voice without taking into account how process of social construction can create opposing views. For example, a lack of safety voice may only be meaningful because beliefs on the nature of physical harm, the desirability of outcomes, and absent behaviours are socially constructed (Lupton, 1999; Turner and Gray, 2009). Yet, what is considered to be safe or desirable may be ambiguous, contested, and altered over time through sense-making processes, and this suggests that future research needs to address the act of raising safety concerns as inherently meaningful, social and embedded in a sociocultural context (Weick, 1995, 2010).

Second, like employee voice (Bashshur and Oc, 2014), safety voice is treated as producing mainly favourable outcomes. However, physical harm may carry a larger cost than unresolved work issues, and this may imply that people would rationally consider it optimal to raise more safety than work issues. This review highlighted that research investigating the complete safety voice process (antecedents, voice pragmatics, output) are scarce, and when outcomes were included these focussed predominantly on prevented physical harm (e.g., preventing wrong site surgery; Blanco et al., 2009). Yet, safety voice outcomes may also be unfavourable (e.g., negative experiences), mixed or ambiguous and the 'expected utility calculus' (Milliken et al., 2003) predicts this would reduce the likelihood of people speaking up. This distinguishes safety voice from employee voice, because this would imply that if each safety voice instance has a cost (e.g., negative responses from others) and each prevented safety incident a significantly larger benefit (e.g., physical harm), then, dependent on the ambiguity of the expected utility of the outcomes, individuals would rationally produce a large number of false alerts for each correct alert in the case of safety voice. Approaches from signal detection theory (Nesse, 2005) and game theory (Brown et al., 1999) have been applied to defensive responses such as fear, and utilising these approaches might prove useful to uncover costs and benefits of safety voice outcomes and potential optimum levels of safety voice.

Finally, based on the lack of research outside of organisational and clinical contexts, the literature seems to have assumed that safety voice is exclusively an organisational phenomenon. This finding highlights an important gap in safety voice research to date: safety risks are not confined to work contexts (Wilson, 1979) and people are concerned about risks that extend well beyond them (e.g., natural hazards, fires; Fischer et al., 1991). Research using experience sampling methods has highlighted that only 29% of people's concerns about physical risks are related to work activities (Hogarth et al., 2007), and concerns relate more often to personal transportation and food safety. Underscoring this, between 1979 and 2014 a total of 288,211 deaths were attributed to non-work related accidents (e.g., motor accidents, drowning, falls, poisoning) in the UK (ONS, 2016). The safety voice literature's emphasis on institutions may have emerged from (i) organisations' desire to manage and control safety and (ii) researchers' desire to use a combination of relevant and accessible data. However, to fully understand the processes involved in voicing safety concerns, the literature needs to expand beyond organisational contexts.

4.3. An ecological framework for safety voice

We set out to uncover the inhibiting and promoting relationships between antecedents, safety voice, and its outcomes across levels of analysis (Bronfenbrenner, 1977; Erez and Gati, 2004; Leveson, 2002). To this end, we proposed an ecological framework for safety voice antecedent and outcomes (see Table 3) that makes three contributions.

First, the framework highlights the ecological nature of safety voice

for antecedents, pragmatics and outcomes. Safety voice can be delineated at Erez and Gati (2004) individual, group, institution and external context levels of analysis, and some variables manifest differently across these levels. For example, power differentials are manifested as individual 'power', group 'hierarchy and leaders' actions', and institutional 'hierarchical structures'. Furthermore, we found that several antecedents related specifically to characteristics of hazards. This is important for safety voice as an ecological phenomenon, because it implies that in addition to outcomes, the unsafe event dynamically shapes and is shaped (i.e., a feedback loop) by the social context of individuals, groups, institutions and external environment. The framework therefore enables a systems approach to safety voice (Leveson, 2002), that is not prescriptive but describes the nature of relationships amongst antecedents, voice pragmatics and outcomes across levels of analysis as dynamic and emergent (White, 1995).

Second, the framework suggests novel directions for research. The framework simultaneously reveals gaps and abundances in knowledge. Arguably, certain domains would not require additional evidence (e.g., workload, receptiveness of others, physical harm, fear for consequences), whereas others would (e.g., unfavourable outcomes, the external context, unconscious processes, characteristics of the hazard). In particular, the literature has put a significant emphasis on antecedents, but a gap remains in terms of a clearer operationalisation of victimhood (i.e., who suffers the physical harm), safety responsibilities (i.e., people who are tasked with managing the safety issue may not speak up), beliefs on hazard characteristics, safety voice pragmatics, and unfavourable outcomes.

Finally, the framework enables improved safety management. It facilitates causal factor analysis for accident investigation (through enabling the identification of causes for silence), and, in particular, the application of evidence-based interventions by ensuring interventions cover the available empirical evidence and identifying suitable loci for novel interventions. For example, based on evidence across levels of analysis, interventions may target the removal of trade-offs, creating (shared) safety knowledge, or providing favourable work configurations and regulation.

4.4. Methodological issues in researching safety voice

Safety voice research is characterised by broad-ranging methods (i.e., quantitative and qualitative), a reliance on post-hoc reports and a need for causal conclusions. These challenges are similar to those outlined by Morrison (2011), yet four methodological challenges require special attention to further the safety voice literature.

First, the field tends to assume that people can report on the antecedents and outcomes of safety voice, and has treated post-hoc reports as reliable data. Post-hoc reports are valuable as they are relatively resource efficient and can enable large sample sizes (e.g., through surveys). However Podsakoff and Organ (1986) pointed out common method variance, motives for consistency and social desirability, and a range of perceptual biases (e.g., confirmation bias, illusory correlations) can bias post-hoc reports. Furthermore, self-reports may be biased through motivations to mitigate social risks (e.g., negative consequences), and supervisor-reports may be inflated through a desire to appear as an effective leader. Also, such findings are often correlational, and the causality of relationships between safety voice and its antecedents and outcomes requires explicit testing.

Second, related to this, data on safety voice occurring in-situ is scarce, and few studies have observed the complete safety voice phenomenon (i.e., antecedents, pragmatics, outcomes). Collecting data in dangerous scenarios (e.g., through exposing or prolonging participants to danger) or operationalising victimhood is ethically challenging (Lee-Treweek and Linkogle, 2000), and the short-lived nature of safety voice means it is difficult to encounter spontaneously. Report-based methodologies (e.g., statements provided in surveys, interviews, etc.) enable the circumvention of this, yet are limited as they do not observe safety voice behaviours (e.g., reports of behaviour are not the behaviour), rely on memory and imagination (e.g., poor memory and social desirability can introduce bias), and cannot establish causal relationships with other antecedent and outcomes (e.g., due to common method bias). Our review revealed limited methodological breadth, and the limitations of report-based methodologies indicates new methodologies are needed to investigate safety voice, for example experience sampling methodologies, text analysis of transcribed conversations on safety, or designing safety voice scenarios for simulations or laboratory settings. This may also address (i) the empirical relationship between safety voice and silence, which Morrison (2011) suggested is outstanding for employee voice, and (ii) the challenge of manipulating risk perceptions without crossing ethical boundaries. Thus, to address this, we investigated the challenges for investigating safety voice, and presented a novel safety voice experiment for use in laboratory settings (Noort et al., 2019).

Third, it remains unclear whether safety voice processes are particular to their industrial or national contexts, and no data on measurement equivalence exists for safety voice in terms of its relevance, construct, and relationship with antecedents and outcomes (Reader et al., 2015). Thus, there is a need to compare results across contexts.

Finally, a need exists to clarify ethical procedures, treatment of missing data, and promote open science. This may be achieved through providing more information during the publication process, and authors need to address whether data can be shared on open platforms.

4.5. Limitations

Several limitations of this systematic review need to be stated. First, additional articles may have been published during the process of writing this article (March 2017 onwards) and the date of publication. A mere product of the academic publication cycle, authors of future safety voice reviews should take this into account. Second, systematic reviews are limited to their search strategy. For this article, the search strategy was limited to include articles when '*safe*' and not 'technolog* were mentioned in the title or abstract. This means that the search strategy may have missed employee voice studies that covered safety but did not mention this in the title or abstract, or voiced concerns through technological means. The initial searches did not reveal any articles in this regard, and we aimed to mitigate this through a hand search. Third, the strength of the safety voice framework is only as strong as the quality of the evidence that underpins it. The quality of articles and associated risk of bias has been addressed in this review, yet the framework may be biased to the extent that the field's assumptions and methods are systematically biased. We addressed above how the field can address this with future research. Finally, this systematic review had a conceptual scope and a need remains for direct empirical comparisons of safety and employee voice to establish their relative predictive validity. This is especially relevant for organisational environments where reducing harm is the main organisational goal (e.g., for air traffic control, healthcare): studies on employee and safety voice may render identical (or highly correlated) findings where the concepts' scopes overlap (i.e., reducing harm through speaking-up in safety-critical organisations).

5. Conclusions

Despite some conceptual and methodological overlap between safety voice and employee voice, we conclude that it is a related but distinct phenomenon due to its unique focus on safety and risk perception, the wider range of stakeholders involved, and the distinct methodologies, antecedents, and outcomes of safety voice. Understanding safety voice as an ecological phenomenon, whereby it can be influenced by hazard, individual, group, organisational, and contextual factors, can help researchers to improve understanding on why people do or do not engage in safety voice, and can support practitioners in developing interventions to enable speaking-up within specific safety-critical situations.

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Declarations of interest

None.

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Appendix A. Supplementary material

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