Literature Review: Measuring Work Safety Climate: A Review of the Research Literature

Research Project: Developing a Brief Version of a Work Safety Climate Measure for Practical Use in Organisations

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Abstract

Safety climate, the shared perceptions of policies, practices and procedures for the protection of worker psychological health and safety within an organisation, is recognised as a leading indicator of safety incidents in workplaces. As such, an assessment of work safety climate can be used to identify safety issues and implement strategies to prevent such incidents. However, the ambiguity of the concept has meant that confusion remains over the definition and measurement of safety climate. The Nordic Safety Climate Questionnaire (NOSACQ-50) has previously been recognised as being useful for identifying issues with safety climate and subsequently implementing strategies for improved safety outcomes. A key issue with this questionnaire is its length; the 50 items can be too long for organisations to utilise. Briefer safety climate measures are needed for practical use if they are to provide a means of monitoring the safety climate on a regular basis. This review aims to outline safety climate, differentiating it from safety culture and identifying factors affecting safety climate and its measurement, including a discussion of brief safety climate measures and their benefits.

Work Safety Climate and Work Safety

Recent years have seen an increased effort to understand the human contribution to accidents in the workplace; in particular, the realisation that accidents in organisations occur within a cultural and social context has led to an increased focus on the concept of safety climate (Cox & Flin, 1998; Glendon, 2008).

Safety climate is often interpreted as the "manifestation of safety culture in the behaviour and expressed attitudes of employees. It represents employee-shared perceptions of the priority an organisation places on safety" (Leitao & Greiner, 2015). Given the significant cost of work related psychological health problems, it is important to have measures to identify, assess and control psychosocial hazards (Hall, Dollard & Coward, 2010). Growing evidence suggests that safety climate is associated with safety practices, accident rates and behaviour, and as such, safety climate is a key leading indicator of safety performance (Brown, Willis & Prussia, 2000; Zohar, 1980). Despite this significant body of research, however, the evidence is difficult to interpret due to various conceptual and methodological issues. For example, the terms safety climate and safety culture have both been used but there is currently little agreement over how to define the two concepts (Guldenmund, 2000; Hopkins, 2006). Literature suggests that the existence of the two concepts of safety climate and safety culture has caused confusion; the constructs are often used interchangeably, creating difficulty in the interpretation of the literature (Zohar, 2003).

Safety Culture

Safety is generally recognised as the combination of behaviours which increase or decrease the risk of harm, and safety culture is viewed as the grouping of characteristics and attitudes within organisations and individuals which establishes that issues regarding safety receive warranted attention (Edwards, Davey & Armstrong, 2013). When considering literature reviews, Antonsen (2009) concluded that safety culture is "a set of safety related

attitudes, values or assumptions that are shared between the members of an organisation" (Antonsen, 2009, p.183). It is essentially "the aspects of the organisational culture, values, attitudes and beliefs which will impact on attitudes and behaviours related to safety increasing or decreasing at work" (Leitao & Greiner, 2015, p.2). Organisational culture is commonly referred to as the shared values and beliefs that interact with an organisation's employees and structures which produce behavioural norms, and as such, there is a degree of acceptance regarding the close relationship between safety culture and organisational culture (Edwards et al., 2013).

A dominant conceptualisation of culture is one whereby the focus is on shared, or common, factors that are either present or absent in a group. It is commonly recognised that culture is the set of shared beliefs or values possessed by all and is reflected in the systems and behaviours within a group, and the thoughts and processes of individuals within this group (Edwards et al., 2013). When applied to safety in organisations, it can be argued that if safety is to be a priority in an organisation then a safety culture ought to be held by individuals and groups; and if it is determined that the safety culture is weak then changes must be made to strengthen it, and if the current safety culture is found to be strong, then processes must be in place to ensure this culture is maintained (Edwards et al., 2013).

Safety Climate

As previously mentioned, safety climate is inherently a multi-level construct, described as the expression of safety culture in the behaviour and attitudes of employees. As such it tends to be more concerned with immediate safety related behaviour and attitudes rather than beliefs about safety and its relative importance that tend to characterise safety culture. Nevertheless, like safety culture, safety climate also reflects the combined views of individuals and groups and is an organisational variable, conceived predominantly as a property of the organisation as opposed to the individual. This has created confusion in the

literature regarding the concept and measurement of safety climate. Zohar (1980) referred to two measurement levels of this construct: group level (concerning perceptions of practice within departments in each organisation) and the organisational level (perceptions regarding policies and procedures within the organisation and general management attitudes towards safety). This construct has also been argued to encompass two managerial levels: employee's perceptions of management's commitment to, and prioritisation of, safety, referred to as organisational safety climate, and secondly, employees' perception of their direct supervisors' commitment to and prioritisation of safety (referred to as group-level safety climate)(Huang, Zohar, Robertson, Garabet, Lee & Murphy, 2013; Zohar & Luria, 2005) . However, the concept of safety climate is essentially recognised as workers' shared perceptions regarding their organisation's policies, procedures and practices in relation to the value and importance of safety within that organisation (Neal & Griffin, 2006; Zohar, 2000, 2002, 2003).

Research indicating that safety climate has a strong association with safety behaviour and psychological wellbeing highlights the importance of having a positive safety climate that creates conditions for employees to be both safe and healthy (Clarke, 2010; Oliver, Cheyne, Tomås & Cox, 2002). Employee perceptions are central to the measurement of safety climate, which is inherently based on individuals' perceptions of the organisation's safety related practices, procedures and rewards (Griffin & Neal, 2000).

It is also important to distinguish psychological safety climate from organisational safety climate (Ostroff, Kinicki & Tamkins, 2003). Psychological safety climate is a facet specific dimension of the more general organisational safety climate that develops from both direct and indirect exposure to policies, procedures and practices (Hall et al., 2010). However, psychological safety climate reflects individuals' perceptions of specific safety related policies, practices and procedures (Ostroff et al., 2003). As such, psychological safety climate is considered a property of the individual and the appropriate level of analysis is at

the individual level as opposed to the organisation level (Parker et al., 2003). Conversely, organisational climate is an emergent group-level phenomenon that constitutes an aggregate of the climate perceptions within a group: therefore an organisational safety climate is the collective perceptions regarding the safety policies, practices and procedures within the workplace (Kozlowski & Klein, 2000).

When measured at the individual level, psychological safety climate, particularly the perception of organisational attributes, has been found to be significantly associated with organisational safety climate (Clarke, 2010). Furthermore, it is recognised that organisational safety climate has a stronger association with injuries than psychological safety climate does (Christian, Bradley, Wallace & Burke, 2009). Employee perceptions regarding the importance of safety are also believed to be affected by the degree to which their managers are viewed to be committed to safety and it is recognised that a meaningful indicator of safety's priority is leadership's perceived commitment to safety (Brown & Holmes, 1986; Cox & Cheyne, 2000; Dedobbeleer & Beland, 1991; Zohar, 2008). If leader commitment to safety is perceived to be high, employees in turn perceive a positive safety climate in which safety is a high priority. As such, managerial commitment to safety is another factor considered to be fundamental, and thus should be included in any safety climate measurement. Zohar (2011) emphasised its importance and encouraged incorporating items into safety climate measures that are directly and indirectly indicative of management safety commitment. Direct measures assess perceptions of leader safety commitment, while indirect measures are more generalised indicators assessing the availability of safety equipment and the communications of safety information (Zohar, 2011).

Safety climate is conceptualised as a distal antecedent of workplace injuries (Zohar, 2003) and is evident at both the psychological and organisational levels. Commonly recognised as based on the individual perceptions of policies, procedures and practices relating to safety in the workplace (Neal, 2006), it provides a framework for safety-related

behaviour within organisations. A positive safety climate has been found to increase employees' feelings of commitment and satisfaction with the organisation as they perceive that safety is prioritised and that their managers are committed to safety (Clarke, 2010). Meta-analyses have provided evidence that safety climate is one of the most robust leading indicators of organisational safety outcomes and essentially, influences employees' motivation and knowledge to act in a safe manner in their workplace (Beus, Payne, Bergman & Arthur, 2010; Christian et al., 2009; Griffin & Neal, 2000). As safety climate informs what resulting outcomes would be expected from behaviours, it would be anticipated that less injuries would result in a supportive safety climate where safe behaviour is reinforced. Conversely, as injuries provide information about the safety of the workplace, they are also considered to be predictive of safety climate. As such, when injuries occur this indicates potential issues with the underlying safety climate in the organisation (Spence, 1973).

Organisations will have safety related policies that are intended to deal with safety related issues and prevent incidents and injuries. However, the concept of safety climate implies that employees will have not only attitudes and behaviours towards work safety but also towards adherence to safety policies. As safety climate is defined as individual perceptions of policies, procedures and practices relating to safety in the workplace, there is a link between safety related policies and safety climate (Neal & Griffin, 2006). Thus an organisation may have appropriate safety policies but a deficient safety climate may reflect a lack of knowledge of, or adherence to, such policies.

Factors Affecting Safety Climate

It is recognised that a range of factors are related to safety climate. Clarke (2010) demonstrated that safety climate has significant correlations with a number of non-safety variables including job satisfaction, organisational commitment and general wellbeing. A partial mediation model was supported in Clarke's study, where the relationship between

safety climate and safety behaviour was found to be partially mediated by work-related attitudes (organisational commitment and job satisfaction) (Clarke, 2010). Additionally, the relationship between safety climate and occupational accidents was partially mediated by both safety behaviour and general health (Clarke, 2010). Although it is argued that managers should aim to develop a positive safety climate in order to reduce the impact of incidents, it is also recognised that as organisational safety climate is held by a group of individuals (Choudhry, Fang & Mohamed, 2007; Cooper, 2000; Crum & Morrow, 2002); safety climate emerges from all levels of an organisation and thus interventions need to have a broader organisational-level focus which may be related to the organisational structure and processes, and the more general organisational culture (Haukelid, 2008).

It is suggested that employees' perceptions of safety policies, practices and procedures (perceived safety climate) are most influenced by their experience of broader organisational elements such as organisational structure and processes (e.g., communication, organisational support, emphasis on rules etc.) (Clarke, 2010). This highlights the importance of broad, multi-level organisational level interventions as opposed to narrow interventions targeted at individual safety behaviours and attitudes. Zohar (2010) highlighted that how safety climate emerges and is influenced over time is not yet fully understood and therefore requires further research (Huang et al., 2017).

Work Safety Measures

A key issue for safety climate measurement is the broad lack of appreciation of the construct's multilevel conceptualisation and content domain, which has led to widely divergent measures that have contributed to the ambiguity of the concept of safety climate (Beus, Payne, Arthur & Manoz, 2017). Beus et al. (2017) discuss the importance of having different dimensions of safety climate in a questionnaire to address theoretically appropriate themes. For example, they found that safety involvement and safety communication were

consistently the highest loading factors across the five samples of their study, indicating that active worker involvement in safety and open communication of safety issues are particularly meaningful indicators of a group's safety climate.

One important influential factor is likely to be an organisation's culture since this affects most aspects of an organisation's functioning. However, this relationship may prove difficult to investigate given the length of some existing organisational culture and safety climate measures.

With respect to the length of some safety climate scales, they also pose problems for their practical application; for example, as a means of monitoring the safety climate so that emerging safety issues can be identified and dealt with before they become major issues resulting in accidents. Accordingly, it would be useful to develop brief safety climate measures for this purpose although it would also be important for them to be sufficiently detailed and allow qualitative comments in order to identify specific safety climate related issues rather than just indicating a problem with the overall safety climate.

The recognition of safety climate as a predictor of safety outcomes has contributed to the development and validation of numerous safety climate surveys, with no one measure yet identified as the most effective (Payne, Bergman, Beuz, Rodriquez & Henning, 2009). This has been partly due to a misunderstanding between the concepts of safety culture versus safety climate, as well as discrepancies regarding the measurement of safety climate. Though generally recognised as a multi-dimensional construct, no consensus currently exists regarding the full range of factors that comprise safety climate (Beus et al., 2010; Payne et al., 2009). Numerous studies treat safety climate as an individual-level concept and as such, employee perceptions are measured at the individual level, with the organisation's safety climate considered as an average of individual responses (Leitao & Greiner, 2015). In contrast, as opposed to focusing on a person's individual perceptions, Zohar (1980) conceptualised safety climate as a social construct influenced by groups of people. From this

perspective, and as previously discussed, Zohar (1980) considers two measurement levels of safety climate: the organisational level (perceptions of the management's general attitudes towards safety and company policies) and the group level (perceptions of the differing departmental practices within each organisation).

Flin, Mearns, O'Connor and Bryden (2000) conducted a review of 18 safety climate measures and concluded that the most commonly assessed factors were management safety commitment, safety systems, and risks; with these factors present in two-thirds of scales reviewed. An additional two factors identified were work pressures and competence. However, Beus et al. (2010) noted insufficient evidence exists that these recognised factors constitute the core conceptual themes of the safety climate construct. Following this, a meta-analysis suggested that when predicting work injuries, management commitment to safety was the most robust predictor (Beus et al., 2010).

In order to address the persisting conceptual ambiguity raising questions concerning what safety climate really is (as operationalised in the literature) and to increase scientific understanding of the construct, Beus et al. (2017) inductively articulated safety climate's general content domain by identifying seven core indicators of safety's perceived workplace priority. These indicators then became the basis for a generalised safety climate measure designed for use across a variety of organisations and construct levels. Using this newly created measure, a multilevel construct validation of safety climate was conducted in two separate studies. Through a process of gathering every unique non-proprietary instrument that has been used in the literature to assess safety climate, obtaining distinct measures of safety climate and having three safety climate subject matter experts evaluate whether each of these items corresponded to the described theoretical conceptualisation of safety climate, the authors came up with seven indicators that sufficiently represented safety climate. These indicators are: leader safety commitment, safety communication, safety training, co-worker

safety practices, safety equipment and housekeeping, safety involvement and safety rewards (Beus et al., 2017).

Based on this work, a short 30 item safety climate measure was administered to employees in three organisational samples: 547 employees from a Chilean mining company, 195 English-speaking contractors at a U.S. petrochemical refinery and 504 employees of a large U.S. petrochemical company. The findings from these three organisational samples confirm the emergence of safety climate and establish safety climate's work-group level factors structure. This also provided evidence that safety climate is conceptually similar across individual and workgroup levels (Beus et al., 2017). Additionally, the responses to the safety climate measure created for the study evidenced improved predictive validity relative to responses from a reputable alternate safety climate measure. The results also provided clarity concerning safety climate's content domain, multidimensionality and factor structure as well as the cross-level functionality (Beus et al., 2017).

Despite the overall success of this study, it was highlighted that a key practical implication is the length of the questionnaire; the authors suggest that organisations may be hesitant to permit a 30-item measure for a single construct. As such, they suggest an alternative of adapting a shorter version that uses a single representative item to reflect each of the seven core indicators (Beus et al., 2017). Again, this supports the importance of developing brief safety climate measures for a useful practical application. However, a limitation of brief measures of this kind is their inability to provide precise information about the nature of particular safety climate related issues that may be essential for dealing with those issues. This is particularly the case where there is no comprehensive questionnaire from which the brief measure is derived that can be used to provide the more precise information required about a particular safety issue.

The idea of management as a driver of safety climate is fundamental to the conceptual foundation of the Psychological Safety Climate scale (PSC), which is an instrument designed

to assess safety climate specifically related to workplace psychological health and stress prevention (Hall et al., 2010; Idris, Dollard, Coward & Dormann, 2012). While recognising the support for a relationship between safety climate and psychological health, it is argued that psychological and physical safety climates differ and thus this facet-specific climate measure is required (Idris et al., 2012). PSC reflects a "communicated management position about the value and priority of worker psychological health and safety in the workplace" (Hall et al., 2010) and is a recognised safety behaviour antecedent (Dollard & Bakker, 2010). PSC is considered to be management driven. As such, in a workplace that is considered to have a high PSC environment, psychological health is a priority and managers are expected to show commitment towards the promotion of psychological health among employees by reducing work stress that can affect safety attitudes and behaviours. In order to measure PSC, Hall, Dollard and Coward (2010) developed a short instrument, the PSC-12. The PSC-12 is a 12 item, four-factor scale which shows expected relationships with psychosocial risk factors (e.g. job demands and job resources), worker engagement and health, and work-related health outcomes (e.g. job satisfaction). However, while its brief nature makes it ideal for research purposes, it assumes that only management related safety climate issues are essential and the small number of items limits its usefulness for identifying specific safety related issues.

The Group-Level Safety Climate Scale developed by Zohar and Luria (2005) has 32 items – 16 measuring organisational-level safety climate and 16 items measuring group-level safety climate. This scale is one of the most widely used safety climate scales and has robust evidence of reliability and validity with a Cronbach's alpha of 0.92 for organisational-level safety climate and 0.95 for group level safety climate (Zohar & Luria, 2005).

The Nordic Safety Climate Questionnaire (NOSACQ-50) was developed by Kines et al. (2011) to measure safety climate, covering dimensions based on previous empirical research and psychological theory, and including measures of management and worker dimensions. The work-group level items focus of this scale is on co-workers; it uses items

prefaced with "we who work here……." as opposed to utilising items designed to determine the importance placed on safety, as seen in Zohar and Luria's Group-Level Safety Climate Scale (2005), which prefaces items with "My direct supervisor……."

Heffernan, Harries and Kirby (2018) used the NOSACQ -50 to investigate the work safety climate for community-based Disability Support Workers and its relationship to physical and mental health and burnout outcomes. The aim of this study was to determine whether both management and workgroup-level (co-worker) safety climate dimensions were important predictors of physical and mental health. Burnout was assessed using the Copenhagen Burnout Inventory (Kristensen, Borritz, Villadsen & Christensen, 2005), which comprises three subscales – work-related burnout, client-related burnout and personal burnout. Finally, physical and mental health was assessed using the SF-8 health survey (Ware, Kosinski, Dewey & Gandek, 2001). This eight item self-report survey measures the extent to which individuals are able to perform their normal or usual behaviours and activities. The results demonstrated that safety climate correlated significantly with physical and mental health. Less favourable climate perceptions were associated with poorer health. The only predictor of physical health was management safety priority, commitment and competence, but mental health was predicted by both management and workgroup-level dimensions. The workgroup-level dimension measuring workers' safety priority and risk non-acceptance was a key mental health predictor, predicting all four mental health measures. Another key predictor was the management dimension measuring management safety empowerment, which predicted all mental health outcomes except client-related burnout, which was predicted by management safety justice. The overall findings of this study suggest workgroup-level safety climate is an important theoretical factor which can add explanatory variance beyond that measured by management dimensions for understanding the association between work safety climate and mental health for community-based workers (Heffernan et al., 2018).

A dilemma that researchers are often faced with is whether to use more comprehensive questionnaires or brief measures as previous research has demonstrated that survey length can negatively impact response rates (Beus et al., 2017). While a longer questionnaire can capture a broader range of construct content, and thereby provide a more in depth understanding of an organisation's safety climate, a brief measure is more likely to boost participant engagement as participants may be more likely to perceive that they have adequate time to respond to a shorter questionnaire (Woods & Hampson, 2005). They may also interpret some items designed to assess reliability (such as negatively worded alternatives) in longer questionnaires as redundant, leading to negative reactions towards the survey (Wanous, Reichers & Hudy, 1997).

The NOSACQ-50 and Zohar and Luria's (2005) measures have 50 and 32 items respectively, meaning both are relatively lengthy questionnaires, but being comprehensive and psychometrically sound they have been widely used. However, the use of these relatively long questionnaires can limit the nature of models that can be tested to explore relations among various related constructs (Fisher, Matthews & Gibbons, 2016). Zohar's (2010) statement that more work is needed to explore which factors contribute to the development of employees' safety climate perceptions within organisations means that additional data on a broader range of variables simultaneously needs to be collected. This is challenging to achieve with the current lengthy safety climate questionnaires available and as such, shorter questionnaires targeting specific organisational factors are required to further explore which of these factors influence safety climate. Huang et al. (2017) were successfully able to shorten Zohar and Luria's (2005) safety climate scale using an Item-Response Theory approach; with all four shortened scales having acceptable reliability (≥ 0.89). To add to this research, it would be beneficial to develop a shorter version of the NOSACQ-50 questionnaire so it can also be used to further explore potential factors influencing both manager and worker aspects of safety climate.

Briefer safety climate measures are also needed for practical use if they are to provide a means of monitoring the safety climate on a regular basis so that emerging safety related issues can be identified and attended to before they become serious issues resulting in accidents. Beus et al. (2017) found that workgroups reporting fewer safety incidents in the six months prior to safety climate assessment tended to have a significantly more favourable safety climate, as reflected by aggregate scores derived from the safety climate measure used. Workgroups with more favourable safety climates tended to report significantly fewer safety incidents in the six months following safety climate assessment. Ultimately, more favourable safety climates are associated with statistically significant decreases in subsequent workgroup injury reports (Beus et al., 2017). Safety climate was found to only be related to future injury reports and not injuries that were reported before safety climate assessment. This provided greater support for the study as it highlights the importance of having good safety climate measures for organisations to utilise at any time, in order to attend to safety issues and so reduce future injuries. Thus, the shortening of safety climate questionnaires needs to retain critical dimensions and items relevant to key aspects of safety climate.

An advantage of having a brief version of a comprehensive scale, rather than develop an alternative brief scale, is that the brief version of the comprehensive scale can be used for monitoring purposes to identify issues, and specific parts of the comprehensive version could then be used to provide more detailed information about the issue identified by the brief version for remediation purposes.

Developing Brief Versions of Work Safety Climate Measures

In order to develop briefer versions of safety climate measures, like the NOSACQ-50, that can be used for both research and practical purposes, consideration needs to be given to which items and / or factors should be removed. Creating a briefer version for research purposes can be achieved using the same Item Response Theory (IRT) approach used by

Huang et al. (2017) to shorten Zohar and Luria's (2005) Safety Climate Scale. IRT assesses multiple psychometric features of individual scale items and is a probabilistic non-linear modelling technique used for developing and evaluating psychological measurement scales; it calculates the respondent's probability of selecting particular response options of each scale item and then estimates each item's ability to differentiate respondents. Huang et al. (2017) shortened the original full length safety climate scales using two methods, (1) selecting items with above-average discriminating ability (i.e. items providing greater than 6.25% of the original scale information) and (2) selecting the items that are most informative – retaining at least 30% of original scale information, resulting in 4-item organisation-level and 4-item group-level safety climate scales. Other considerations include the extent to which certain types of questions, such as negatively worded versions of similar positive items for reliability purposes could be deleted. It is argued that the use of negatively formulated items as well as positive items reduces stereotype response patterns (Kines, 2011). However, depending of the extent of this effect, the number of items could be reduced by removing negative alternatives, particularly if such items are subject to misinterpretation, indicated by responses that are contrary to the positive worded similar items. Factors which can lead to misinterpretation include, amongst other things, questions with high reading levels, making the questionnaire difficult to interpret for some respondents and thus potentially leading to them not being answered truthfully. Additionally, where measures contain items that are very similar for reliability purposes, participants may interpret these items as being repetitive or redundant, potentially resulting in negative reactions toward the survey (Wanous et al., 1997).

Shortening the length of a questionnaire could result in individuals perceiving that they have sufficient time to answer questions and give a considered response, even when they do not feel that their participation will directly benefit themselves (Woods and Hampson, 2005).

The challenge then for developing a brief version of a more comprehensive work safety climate measure is to construct a scale that maximises its usefulness in identifying particular work safety issues that need to be attended to (and might be further investigated by relevant parts of the longer more comprehensive version) while retaining as much of its reliability and predictive power as possible. The development of such scales is needed to facilitate research concerning the concept of work safety climate and its practical use as a means of identifying particular safety issues that can be addressed to prevent them developing into safety incidents.

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Developing a Brief Version of a Work Safety Climate Measure for Practical Use in Organisations

[redacted]

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Abstract

Work safety climate, considered to be the expression of safety culture in the behaviour and attitudes of employees, has been shown to be a leading indicator of safety incidents in organisations. As such an assessment of work safety climate can be used to identify safety issues and implement strategies to deal effectively with these issues. A safety climate measure, the Nordic Safety Climate Questionnaire (NOSACQ-50), has been shown to be useful for implementing strategies that improved safety outcomes, including reduced stress, sick leave and work compensation claims, was considered as a basis for the development of a briefer version suitable for monitoring of work safety climate. In addition to the traditional statistical procedures for identifying the most reliable and valid items in the questionnaire, consideration was given to ensuring that items retained would be useful to identify key aspects of work safety behaviours and attitudes of managers and co-workers that would be useful to provide a basis for appropriate strategies to address the identified issues. Using data from 366 disability support workers, this approach provided a brief version of the work safety climate that was found to provide similar significant correlations with stress and health outcome variables as the complete version and a similar comprehensive manager and co-worker profile of work safety climate behaviours and attitudes. Further research was recommended to enhance its reliability and validity and to demonstrate its practical usefulness.

Keywords: safety climate; organisation-level safety climate; workgroup-level safety climate; scale reduction; psychosocial safety; disability support workers

Developing a Brief Version of a Work Safety Climate Measure for Practical Use in Organisations

Recent years have seen an increased effort to understand the human contribution to accidents in the workplace; in particular, the realisation that accidents in organisations occur within a cultural and social context has led to an increased focus on the concept of safety climate (Cox & Flin, 1998; Glendon, 2008). Safety climate is often interpreted as the "manifestation of safety culture in the behaviour and expressed attitudes of employees. It represents employee-shared perceptions of the priority an organisation places on safety" (Leitao & Greiner, 2015). Given the significant cost of work related psychological health problems, it is important to have measures to identify, assess and control psychosocial hazards (Hall, Dollard, & Coward, 2010).

Growing evidence suggests that safety climate is associated with safety practices, accident rates and behaviour, and as such, safety climate is a key leading indicator of safety performance (Brown, Willis, & Prussia, 2000; Zohar, 1980). Despite this significant body of research, however, the evidence is difficult to interpret due to various conceptual and methodological issues. For example, the terms safety climate and safety culture have both been used but there is currently little agreement over how to define the two concepts (Guldenmund, 2000; Hopkins, 2006). Literature suggests that the existence of the two concepts of safety climate and safety culture has caused confusion; the constructs are often used interchangeably, creating difficulty in the interpretation of the literature (Zohar, 2003).

When considering literature reviews, Antonsen (2009) concluded that safety culture is essentially "the aspects of the organisational culture, values, attitudes and beliefs which will impact on attitudes and behaviours related to safety increasing or decreasing at work" (Leitao & Greiner, 2015, p. 2). Safety climate, which can be described as the expression of safety culture in the behaviour and attitudes of employees, tends to be more concerned with

immediate safety related behaviour and attitudes rather than the more deeply held beliefs about safety and its relative importance that tend to characterise safety culture.

Meta-analyses have provided evidence that safety climate is one of the most robust leading indicators of organisational safety outcomes and essentially, influences employees' motivation and knowledge to act in a safe manner in their workplace (Beus, Payne, Bergman, & Arthur, 2010; Christian, 2009; Griffin & Neal, 2000). As safety climate informs what resulting outcomes would be expected from behaviours, it would be expected that less injuries would result in a supportive safety climate where safe behaviour is reinforced. Conversely, as injuries provide information about the safety of the workplace, they are also considered to be indicative of safety climate. As such, when injuries occur this indicates potential issues with the underlying safety climate in the organisation (Spence, 1973). Organisations tend to react to work safety outcomes such as incidents resulting in injuries, stress, sick leave and work compensation claims by developing policies which are designed to guide safe work behaviours and penalise policy violations. Safety climate is recognised as facet specific and refers to shared perceptions of "policies, practices and procedures for the protection of worker psychological health and safety" (Dollard and Bakker, 2010). As such, the extent to which safety policies are adhered to will be partly determined by the work safety climate, a positive work safety climate being associated with safe work behaviours and a negative climate resulting in policy violations.

The recognition of safety climate as a predictor of safety outcomes has contributed to the development and validation of numerous safety climate surveys. However, though generally recognised as a multi-dimensional construct, no consensus currently exists regarding the factors that comprise safety climate (Beus et al., 2010; Payne, Bergman, Beus, Rodriquez, & Henning, 2009). Flin et al. (2000) conducted a review of 18 safety climate measures and concluded that the most commonly assessed factors were management safety commitment, safety systems, and risks; with these factors present in two-thirds of scales

reviewed. An additional two factors identified were work pressures and competence (Flin, 2000). However, Beus et al. (2010) noted insufficient evidence that these five recognised factors constitute the core conceptual themes of the safety climate construct. Following this, a meta-analysis argued that when predicting work injuries, a measure of management commitment to safety was the most robust predictor (Beus et al., 2010).

The idea of management as a driver of safety climate is fundamental to the conceptual foundation of one particular measure of safety climate: the Psychological Safety Climate scale (PSC), which is an instrument designed to assess safety climate specifically related to workplace psychological health and stress prevention (Hall et al., 2010; Idris, Dollard, Coward, & Dormann, 2012). The PSC-12 is a 12 item, four-factor scale that shows expected relationships with psychosocial risk factors (e.g. job demands and job resources), worker engagement and health, and work-related health outcomes (e.g. job satisfaction). However, while its brief nature makes it ideal for research purposes, it assumes that only management related safety climate issues are essential, and the small number of items limits its usefulness for identifying specific safety related issues.

Other measures of work safety climate are more comprehensive and assume that worker attitudes and behaviours are also important in addition to those of managers. For example, the Nordic Safety Climate Questionnaire (NOSACQ-50) developed by Kines et al. (2011) includes measures of seven dimensions: three management or organisation-level factors and four co-worker or work-group level factors.

Heffernan, Harries and Kirby (2017) used the NOSACQ -50 to investigate work safety climate for community-based Disability Support Workers and examined its relationship to physical and mental health and burnout outcomes. The results demonstrated that safety climate correlated significantly with physical and mental health. Less favourable climate perceptions were associated with poorer health. Regression analyses showed that the only predictor of physical health was management safety priority, commitment and

competence, but mental health was predicted by both management and workgroup-level dimensions. The overall findings suggested that workgroup-level safety climate is an important theoretical factor that can add explanatory variance beyond that measured by management dimensions for understanding of association between work safety climate and mental health for community-based workers.

A dilemma that researchers often face is whether to use a more comprehensive questionnaire or a brief measure. While a longer questionnaire can capture a broader range of construct content, and thereby provide a more in-depth understanding of an organisation's safety climate, brief measures can be more efficient for data collection and can boost participant engagement due to perceptions that they have adequate time to respond (Huang et al., 2017). This has led some researchers to create briefer versions of more comprehensive measures. For example, Huang et al. (2017) were successfully able to shorten Zohar and Luria's (2005) Safety Climate scale using an Item-Response Theory approach; with all four shortened scales having acceptable reliability (≥ 0.89). An advantage of a shortened version of a more comprehensive scale like the NOSACQ-50 is that the shortened version could be used for monitoring purposes and identified aspects of the safety climate could be further investigated using the relevant parts of the more comprehensive scale. Brief versions for monitoring purposes could enable emerging problems in the work safety climate to be identified and dealt with before they lead to incidents or accidents. However, to be useful for this purpose, shortened versions need to retain critical dimensions and items relevant to key aspects of safety climate. This implies that such shortening should consider more than just statistical procedures for identifying critical items related to reliability and prediction of dependent measures. Brief versions of longer scales that are used for research purposes are often restricted to statistical procedures for shortening, because the aim is to achieve an overall measure than is sufficiently reliable and valid to be used in a survey investigating its relationships with other independent or dependant measures. For example, Huang et al.

(2017), who utilised statistical analyses including Item Response Theory to shorten Zohar and Luria's (2005) Safety Climate Scale.

The aim of the present study was to develop a shortened version of the NOSACQ-50, that would maximise its usefulness for monitoring the work safety attitudes and behaviours of both managers and workers. It is anticipated that its items could be used to identify particular safety issues (for further investigation using relevant parts of the more comprehensive version) while retaining as much of its reliability and predictive power as a leading indicator of safety performance, which in this study was considered in terms of both physical and mental health outcomes.

Method

Participants

The data used for this study were from a previous study using the NOSACQ-50 work safety climate measure, to investigate psychosocial issues in Disability Support Workers in a government disability organisation, providing residential care facilities in the community for adults with a wide range of different types and levels of disabilities (Kirby, Harries, Ford, & Sarris, 2017).

The data used were drawn from a database of 366 participants (167 males, 195 females, 4 gender not specified) with ages ranging from 19 to 68 years (mean age = 49.15 years, SD = 10.89). In regard to preferred language, 98.4% (306) participants identified as speaking English, with the others identifying as speaking English (Hindi), Vietnamese, English (Tagalog), Malaysian, and Tamil. These participants worked shift rosters in residential houses in the community, generally with a small team of co-workers and a shift supervisor responsible for monitoring the staff in a number of different houses, meaning that participants worked without direct supervision for much of the working week.

Measures

Responses used in this study were drawn from a larger questionnaire that gathered information regarding worker demographics (e.g., age, gender, country of birth), employment characteristics (e.g., length of service, hours worked per fortnight), job satisfaction, and safety perceptions. Also included in this questionnaire were three standardised measures, which comprised a measure of safety climate and two measures of health and wellbeing. In addition to these standardised measures, the questionnaire included qualitative questions to provide DSWs with opportunities to record comments to elaborate on or qualify responses on each of the measures.

Safety climate.

Safety climate was measured using the Nordic Occupational Safety Climate Questionnaire (NOSACQ-50; Kines et al., 2011) which uses a 4-point scale of strongly disagree, disagree, agree, and strongly agree for all items. The NOSACQ-50 also comprises positively and negatively phrased items. The normative sample consisted of 3853 health care sector workers. The NOSACQ-50 includes seven safety climate dimensions, including three management and four work group level dimensions. Management items are worded as "management……." and work group items are worded as "we who work here …….". The three management-level dimensions are: management safety priority, commitment and competence; management safety empowerment; and management safety justice. The four work-group level dimensions are: workers' safety commitment; workers' safety priority and risk non-acceptance; peer safety communication, learning, and trust in co-worker's safety competence; and workers' trust in the efficacy of safety systems. Scores for these dimensions are obtained by summing items and dividing by the number of items in the dimension to provide an average score that can be considered in terms of the following criteria: dimension scores of 3.30 or more indicates a good safety climate for maintaining and continuing safety development; 3.00 to 3.30 reflect a fairly good safety climate with a slight need for

improvement indicated; 2.70 to 2.99 suggest a fairly low perceived safety climate with need for improvement; and scores below 2.70 indicate a low safety climate with a great need for improvement.

Health and wellbeing measures.

Two standardised measures of health and wellbeing were included in this study, with the association between these measures and the safety climate measure reflecting the extent to which the full and brief versions of the NOSACQ could serve as a leading safety performance indicator with respect to physical and mental concerns for Disability Support Workers.

Burnout was assessed using the Copenhagen Burnout Inventory (CBI; Kristensen, Borritz, Villadsen, & Christensen, 2005), which comprises three subscales with item responses rated on a 5-point scale (0 = *never/almost never* or *to a very low degree* to 100 = *always* or *to a very high degree*). Higher scores represent more burnout, with the mean of 50 or greater considered as indicating burnout. The association between burnout and physical and psychological fatigue and exhaustion is central to the CBI and thus the subscale structure of the Inventory reflects attribution of exhaustion to specific life domains. The personal burnout subscale consists of six items and assesses exhaustion regardless of occupational status. The extent to which exhaustion is perceived as related to work is measured by the subscale work-related burnout, which comprises seven items and the extent to which exhaustion is perceived as related to client is measured by the client-related burnout, which consists of six items. The normative sample comprised 1914 human service sector workers.

Mental and physical health was measured using the SF-8 Health Survey (Ware, Kosinski, Dewey, & Gandek, 2001). The SF-8 is a self-report survey that looks at the extent to which individuals are currently able to perform their normal or usual behaviours and activities. It has a norm-based scoring system and provides a Mental Health Component Summary score as well as a Physical Health Component Summary score. Higher scores

indicate better health (scores above and below 50 are interpreted as above or below the average for the general US population).

Procedure

Statistical Analyses

Quantitative data analyses were conducted using SPSS software Version 20. Due to violations of normality assumptions, bootstrapping using the bias-corrected and accelerated method with 1000 iterations was used to confirm findings using calculated confidence intervals.

Item Reduction Methods

Most attempts to shorten measures involve adopting a variety of statistical approaches to gather and analyse data. However, with an aim to reduce the NOSACQ-50 and have a shortened version that was valid for practical use in organisations, a variety of different procedures were also utilised in this study. Five approaches, including a combination of standard statistical analyses as well as other methods to analyse the practical usability of the questions, were used to determine which items should remain in the shortened scale as described below.

The first method used was to conduct an exploratory factor analysis of the NOSACQ-50 data. Principal Components extraction with oblimin rotation was undertaken to identify factors with eigenvalues greater than or equal to 1.0, with the pattern matrix reported for factor loadings of 0.4 or above (Field, 2009). Following a full factor analysis of the data the researchers then calculated the Cronbach's alpha for each of the items within the seven dimensions to determine the internal consistency of the dimensions and to obtain the alpha values if items were deleted from a dimension. This provided additional support for keeping or removing certain items based on the strength of their relationships. The final statistical

approach involved examining the correlations of each item with the dependent variables (burnout and mental and physical health). This was also repeated once the shortened questionnaire had been determined to confirm that the correlations did not vary significantly from the original version.

Following the combination of standard statistical analysis that would normally be undertaken for scale development, the researchers furthered the study by looking at other factors, such as the context of the questions that were considered important in assessing whether the safety climate measure is practically useful to be able to correctly identify any safety related issues within an organisation. This was done using two methods: (1) assessing the reading grade level of each question to ensure that they are correctly understood, and (2) having five associated researchers independently assess the questions, to decide which they would consider to be most important if they were a safety officer in an organisation which is having some issues with safety, similar to the process undertaken by Beus, Payne, Arthur, and Muñoz (2017). Reading age is relevant to the reliability of scales of this kind that are likely to be used, as in the data set used in this study, with workers many of whom may not have English as their first language, even though they may identify as speaking English.

In order to ascertain the reading level of each question of the NOSACQ-50, the Flesch-Kincaid Readability tests were conducted using the reading level tool in Microsoft Word. These tests are designed to indicate the difficulty of a passage of English writing. Specifically, the Flesch-Kincaid Readability test presents the score as a U.S. grade level, which when above 10, is the number of years of education generally required to understand the passage. The calculation weights total words and syllables for each sentence. Each NOSACQ-50 question was saved into a Microsoft Word document, and then selected individually to have the reading level measured. Finally, the five researchers independently assessed the questionnaire, choosing 2-3 items from each dimension that they believed were

most important to remain in order for the questionnaire to be able to efficiently assess issues with safety climate in an organisation. Following independent analysis, the researchers came together and discussed their choices, coming to an agreement over which items were most useful and those that were not. This defined a total importance rating based on the choices, with five considered most important with all five researchers agreeing and zero being not at all important, with that question not having been chosen by any of the researchers.

Ethics

Permission for this research was gained from the University of Adelaide Ethics Committee. As de-identified existing data were used for this study in association with the researchers who carried out the original study, there were no ethical issues concerning participants who had contributed the data.

Results

Item Reduction Results

Principal Components extraction conducted using the 50 NOSACQ items produced 10 factors with eigenvalues greater than 1.0. The pattern matrix produced by this 10-factor solution is presented in Table A1 in the Appendix. Evident from this table is that management items largely loaded on one factor, which had an eigenvalue of 16.5 and accounted for 33.0% of the variance. This is consistent with Beus et al's. (2017) study, which showed a single dominant management factor. Two other small management factors were obtained, and both contained items from the *Management safety priority, commitment and competence* dimension. The remaining factors all represented co-worker factors, with three of the four factors suggesting good representation of co-worker dimensions; however, this was less so for the *Workers' safety priority and risk non-acceptance* dimensions where factor loadings for the items were spread across three different factors. These factor loading values

findings were used in conjunction with the following analyses to select individual items for inclusion in the brief NOSACQ scale.

Cronbach's alpha calculations were examined next to assist with determining which of the items should be retained or removed to create a brief NOSACQ version, with the results summarised in Table 1 (see Table A2 in the Appendix for full results). As can be seen the Cronbach's alpha values remain very similar for all seven dimensions when individual items are removed, suggesting reliable dimension construction by the NOSACQ-50 developers. Nonetheless, there were four items, all co-worker items, whose removal would lead to an improved alpha value for the individual dimensions.

Table 1

Summary of the Cronbach's alpha values for each dimension when individual items are deleted and items whose deletion leads to an improved alpha value for a dimension.

NOSACQ dimensions	α	α range (with items removed)	Items whose removal improves dimension α
Management safety priority, commitment and competence	.88	0.85 – 0.88	-
Management safety empowerment	.90	0.88	-
Management safety justice	.87	0.83 – 0.87	-
Workers' safety commitment	.72	0.66 – 0.75	26
Workers' safety priority and risk non-acceptance	.74	0.68 – 0.78	33, 34
Peer safety communication learning, and trust in safety ability	.90	0.87 – 0.91	41
Workers' trust in efficacy of safety systems	.83	0.79 – 0.82	

Note. α = Cronbach's alpha

Correlations with each of the health and wellbeing dependent variables was the final statistical approach used to determine which of the items should be retained or removed for a brief NOSACQ version, with the results summarised in Table 2 (see Table A2 in the

Appendix for full results). As can be seen in Table 2, all management items correlated significantly with each of the health and wellbeing measures. The only co-worker item that did not correlate significantly with any of the measures was item number 47 (*We who work here consider early planning for safety as meaningless*). In addition to this item, there were three other co-worker items that correlated with two or less of the dependent measures, in particular item 34 (*We who work here consider that our work is unsuitable for cowards*), item 41 (*We who work here seldom talk about safety*), and item 50 (*We who work here consider it important to have clear-cut goals for safety*). Of the 28 co-worker items, only 11 (39%) correlated significantly with the SF-8 Physical Health measure.

Table 2

Summary of the correlation coefficients obtained between each of the NOSACQ items and the five health and wellbeing measures

NOSACQ dimensions	Correlation coefficient range					Items not correlated with all five health and wellbeing measures	Items not correlated with any health and wellbeing measures
	Personal Stress	Work-Related Stress	Client-Related Stress	SF-8 Mental Health Score	SF-8 Physical Health Score		
Management safety priority, commitment and competence	-.23 to -.34	-.24 to -.40	-.16 to -.28	.19 to .30	.16 to .26		
Management safety empowerment	-.26 to -.36	-.33 to -.41	-.19 to -.33	.21 to .36	.15 to .24		
Management safety justice	-.21 to -.37	-.29 to -.42	-.21 to -.34	.18 to .29	.14 to .25		
Workers' safety commitment	-.08 to -.22	-.14 to -.21	-.09 to -.17	.07 to .16	.05 to .11	23, 24, 25, 26, 27, 28	
Workers' safety priority and risk non-acceptance	-.07 to -.30	-.16 to -.35	-.14 to -.33	.10 to .31	.01 to .19	31, 33, 34, 35	
Peer safety communication learning, and trust in safety ability	-.13 to -.28	-.10 to -.34	-.07 to -.24	.04 to .21	.03 to .20	36, 39, 41, 42	
Workers' trust in efficacy of safety systems	-.08 to -.18	-.07 to -.22	-.09 to -.21	.03 to .16	.07 to .16	44, 47, 48, 49, 50	47

Table 3 provides a summary of the *Flesch Kincaid Reading Grade Levels* for items in each of the NOSACQ dimensions (see Table A2 in the Appendix for full results). It can be seen that the readability level of each of the NOSACQ-50 items ranges from 4.7 as the lowest level and therefore easiest, to 24.4 as the highest and therefore the most difficult to understand. The average reading level for the NOSACQ-50 is 11.8 (Management = 15.3, Co-worker = 9.06). Hall et al. (2010) note that the recommended readability level for scales such as safety climate tools is 7.0 to 8.0, that is at the level that is understandable to an average eighth-grade student. As can be seen in Table 3, all items in this range fell in three co-worker dimensions.

Table 3

Summary of the Flesch Kincaid Reading Grade Levels for items in each of the NOSACQ dimensions items.

NOSACQ dimensions	*Flesch Kincaid Reading Grade Levels*		Items exceeding recommended reading level
	Range	Average NOSACQ-50	
Management safety priority, commitment and competence	9.4 – 20.2	13.5	All items
Management safety empowerment	13 – 22.9	17.0	All items
Management safety justice	11.7 – 24.4	16.0	All items
Workers' safety commitment	4.7 – 10.7	8.0	23, 24, 28
Workers' safety priority and risk non-acceptance	6.2 – 9.9	8.2	29, 30, 31, 33, 34
Peer safety communication learning, and trust in safety ability	6 – 14.3	8.8	36, 38, 39, 40, 42, 43
Workers' trust in efficacy of safety systems	9.2 – 13.7	11.1	All items

Table 4 details the independent choices the researchers made when considering which management factor questions they considered should remain for the shortened safety climate

questionnaire to be most effective to identify safety issues within organisations (see Table A2 in the Appendix for full results). As can be seen, only one question, item 20 (*Management looks for causes, not guilty persons, when an accident occurs*) had full agreement. Nine questions had 4/5 agreement, 7 had 3/5, 5 had 2/5, 15 had 1/5, and 11 which were not selected at all and were therefore considered the least important.

Table 4

Summary of the researcher importance ratings for items in each of the NOSACQ dimensions items.

NOSACQ dimensions	Range	Item numbers according to number of researchers rating importance					
		0/5	1/5	2/5	3/5	4/5	5/5
Management safety priority, commitment and competence	0 - 5	3, 6, 8	4, 5, 9	2		1, 7	
Management safety empowerment	0 - 4	11, 13, 15	12		14	10, 16	
Management safety justice	0 - 4	19, 21	22	18		17	20
Workers' safety commitment	0 - 4	25	24, 28	26		23, 27	
Workers' safety priority and risk non-acceptance	0 - 4	31, 34	29, 33		30, 35	32	
Peer safety communication learning, and trust in safety ability	0 - 4	41, 42	37, 38, 40		39, 43	36	
Workers' trust in efficacy of safety systems	1 - 3		45, 47, 49	44, 50	46, 49		

On the basis of the above results, items were chosen from each of the seven dimensions for the brief version using various combinations of the statistical and practical reduction criteria such that the number of items in the brief version was approximately half of that in the full version and each of the seven dimensions were represented in the brief version of the scale. Criteria considered included: the item loaded on the factor considered to represent the relevant management of co-worker dimension; the item correlated with the

health and wellbeing dimensions, particularly with work-related or client-related stress and physical health where possible; reliability estimates for the dimension would remain generally similar to the full-scale Cronbach's alpha if the item was deleted; the readability grade of the item was close to the desired 7-8 grade level; and the item was considered by the researchers as important. For example, the question *Management encourages employees here to work in accordance with safety rules – even when the work schedule is tight* was selected for the brief version as the Cronbach's alpha remained a similar reliability at .86, correlation coefficients were significant, and four of the five researchers considered it to be important.

In order to ensure an adequate number of items for each dimension, there were some examples where these criteria were not able to be achieved; for example, the readability level of the selected management items exceeded the recommended reading grade level as there were no items in the full scale that fit the 7-8 grade level or lower criteria. Both the complete NOSACQ-50 and the brief version have items higher than the desirable level of reading, but this is similar to other work safety climate scales such as the PSC-12 scale produced by Hall, et al. (2010).

Full and Brief Version Comparison

Table 5 provides the descriptive and reliability statistics for the seven NOSACQ dimensions established using both the 50 NOSACQ items and the brief version. The reliability for the full NOSACQ-50 dimensions range from .72 to .90 whereas the range for the brief version is .49 to .83. Two co-worker dimensions from the brief NOSACQ version, that is the *Workers' safety priority and risk non-acceptance* and *Peer safety communication learning, and trust in safety ability* dimensions, fell below the recommended minimum 0.7-0.8 range (Field, 2009) indicating scale reliability may be an issue for these dimensions.

Table 5

Descriptive and reliability statistics for the seven NOSACQ-50 dimensions from the full and brief versions of the NOSACQ for the Disability Support Worker sample (N=366).

NOSACQ dimensions	NOSACQ Version (no. of items)	Range	Mean	SD	α	CI
Management safety priority, commitment and competence	Full (9)	1.00-4.00	2.91	0.54	.88	.86 - .90
	Brief (4)	1.00-4.00	3.00	0.62	.83	.79 - .85
Management safety empowerment	Full (7)	1.00-4.00	2.81	0.57	.90	.88 - .91
	Brief (3)	1.00-4.00	2.80	0.58	.76	.71 - .80
Management safety justice	Full (6)	1.00-4.00	2.83	0.57	.87	.84 - .89
	Brief (3)	1.00-4.00	2.84	0.60	.79	.75 - .82
Workers' safety commitment	Full (6)	1.00-4.00	3.13	0.44	.72	.68 - .77
	Brief (3)	1.33-4.00	3.10	0.45	.49	.39 - .58
Workers' safety priority and risk non-acceptance	Full (7)	1.00-4.00	2.89	0.50	.74	.70 - .78
	Brief (3)	1.00-4.00	2.91	0.59	.67	.60 - .72
Peer safety communication learning, and trust in safety ability	Full (8)	1.00-4.00	3.10	0.47	.90	.88 - .91
	Brief (4)	1.25-4.00	3.14	0.49	.83	.80 - .86
Workers' trust in efficacy of safety systems	Full (7)	1.00-4.00	3.15	0.45	.83	.80 - .86
	Brief (3)	1.00-4.00	3.21	0.51	.76	.71 - .80

Note. α = Cronbach's alpha; CI = 95% confidence intervals

In terms of the level of safety climate identified using the mean scores shown in Table 5, it can be seen that the safety climate was rated by the Disability Support Workers as being in the fairly low safety climate range (i.e., scores of 2.70 to 2.99) for all three management dimensions using the full version of the scale. When the means for the brief version are considered it can be seen that the mean for the *Management safety priority, commitment and competence* dimension improved, moving the rating into the lowest score of the fairly good safety climate range (i.e., scores of 3.00 to 3.30). All but one of the four co-worker dimensions were rated as falling in the fairly good work safety climate range on the full version of the NOSACQ, and these classifications were maintained when considering the brief version mean scores. The *Workers' safety priority and risk non-acceptance* was

classified in the fairly low perceived safety with need for improvement category and this classification was maintained when using the brief NOSACQ version. These findings suggest that only minor refinement of the brief version may be required to ensure the brief version produces a safety climate profile that is consistent with the full version of the NOSACQ.

Table 6 provides the descriptive and reliability statistics for each of the health and wellbeing dependent measures used, with all possessing adequate reliability for subsequent analyses with alphas ranging from .85 to .90. As can be seen in Table 6, when compared to the normative samples using one-sample t-tests, the Disability Support Worker sample were experiencing significantly more personal and work-related stress and poorer mental health than the normative group. In contrast, the Disability Support Workers reported significantly less client-related stress than was the case in the normative sample and did not differ in respect to physical health.

Table 6

Descriptive and reliability statistics for the five health and wellbeing dependent measures for the Disability Support Worker sample (N=366).

	Disability Support Workers					Normative sample	
Health and Wellbeing Measures	Range	Mean	SD	α	CI	Mean	SD
Copenhagen Burnout Inventory							
Personal Stress	0 - 100	42.0***	19.5	.90	.88 - .92	35.9	16.5
Work-Related Stress	0 – 100	36.6**	20.7	.90	.87 - .91	33.0	17.7
Client-Related Stress	0 – 95.8	22.8**	19.4	.85	.82 - .87	30.9	17.6
SF-8							
Mental Health	19.2 – 63.7	49.7	8.6	.87	.85 - .89	50	10
Physical Health	11.4 – 62.9	48.1**	10.8	.87	.85 - .89	50	10

Note. α = Cronbach's alpha; CI = 95% confidence intervals
** p< .01*** p<.001

Correlations conducted between the health and wellbeing dependent measures and the seven NOSACQ dimensions using both the full and brief versions are shown in Table 7. The

profile of correlations for the brief version is very similar to that produced by the full version, suggesting that the brief version may be a suitable leading indicator measure for safety performance for both mental and physical health concerns.

Table 7

Correlations between the NOSACQ dimensions (full and brief versions) with the five health and wellbeing dependent measures for the Disability Support Worker sample (N=366).

NOSACQ dimensions	NOSACQ Version	Personal Stress	Work-Related Stress	Client-Related Stress	Mental Health Score	Physical Health Score
Management safety priority, commitment and competence	Full	-.40***	-.48***	-.33***	.34***	.28***
	Brief	-.36***	-.44***	-.33***	.33***	.25***
Management safety empowerment	Full	-.42***	-.49***	-.35***	.34***	.25***
	Brief	-.38***	-.44***	-.34***	.34***	.28***
Management safety justice	Full	-.40***	-.48***	-.35***	.29***	.27***
	Brief	-.36***	-.43***	-.33***	.31***	.27***
Workers' safety commitment	Full	-.26***	-.28***	-.20***	.18**	.12*
	Brief	-.26***	-.27***	-.17**	.16**	.13*
Workers' safety priority and risk non-acceptance	Full	-.32***	-.40***	-.38***	.30***	.15**
	Brief	.34***	-.40***	-.37***	.36***	.19**
Peer safety communication learning, and trust in safety ability	Full	-.26***	-.28***	-.19***	.17**	.13*
	Brief	-.24***	-.26***	-.21***	.20***	.13*
Workers' trust in efficacy of safety systems	Full	-.21***	.22***	-.20***	.16**	.13*
	Brief	-.18***	-.22***	-.23***	.17**	.12*

- p<.05** p< .01*** p<.001

Table 8 demonstrates the reading level comparison of the full and brief NOSACQ-50. The readability level of the brief NOSACQ-50 items ranges from 4.7 as the lowest level to 24.4 as the highest, which does not differ from the full version. The average reading level of the brief NOSACQ-50 is 11.6, which is only slightly lower than the full version

of 11.8. The average reading level of the *Management safety empowerment* and each of the co-worker dimensions were lower in the brief version.

Table 8

Comparison of the Flesch Kincaid Reading Grade Levels for items in each of the full and brief NOSACQ dimensions items.

NOSACQ dimensions	*Flesch Kincaid Reading Grade Levels (full version)*		*Flesch Kincaid Reading Grade Levels (brief version)*	
	Range	Average NOSACQ-50	Range	Average NOSACQ-50
Management safety priority, commitment and competence	9.4 – 20.2	13.5	10.1 – 20.2	15.2
Management safety empowerment	13 – 22.9	17.0	13 – 19.9	15.7
Management safety justice	11.7 – 24.4	16.0	11.7 – 24.4	16.7
Workers' safety commitment	4.7 – 10.7	8.0	4.7 – 8.3	6.6
Workers' safety priority and risk non-acceptance	6.2 – 9.9	8.2	6.2 – 9	7.3
Peer safety communication learning, and trust in safety ability	6 – 14.3	8.8	7.7 – 9.1	8.6
Workers' trust in efficacy of safety systems	9.2 – 13.7	11.1	10.1 – 11.7	10.9

Although there was no direct estimate of the time taken to complete the brief version developed, assuming it would take an approximately similar time to complete each item of the scale, the time taken to complete the brief version would be reduced by over 50%.

Discussion

Although research has shown that measures of work safety climate can be used as leading indicators of safety incidents and accordingly provide a basis for identifying and dealing with emerging safety issues before they become critical, research has also shown that the length of such questionnaires can be a disincentive to their use, particularly their regular

use for monitoring purposes. A brief version of a work safety climate measure might therefore be more useful for monitoring purposes, and an advantage of basing it on an existing longer more comprehensive measure would be that relevant parts of the longer measure could be used to provide more detailed information about safety issues identified by the brief version.

This study looked at the use of the NOSACQ-50 within an organisation employing Disability Support Workers and using this data, attempted to shorten the NOSACQ-50 while preserving its reliability, its validity in terms of its correlations with dependent work safety outcomes measures including work stress and health, and its practical usefulness in identifying important aspects of work safety behaviours and attitudes. Although statistical methods were used in an attempt to shorten the questionnaire while preserving its reliability and validity, additional non-statistical methods were needed to ensure its practical usefulness in identifying a range of important safety issues.

The statistical analysis of the long NOSACQ-50 and the shortened version developed during this study suggest that the shortened version is generally similar to the complete version in terms of its reliability, although the reliability of some of the component factors were below desirable levels, indicating that further combinations of items should be considered for these factors to increase their reliability levels. This would need to be done with careful consideration of the items selected to ensure that the practical usefulness of the items for identifying specific safety issues was preserved. Statistical analysis also indicated that the brief version provided a very similar profile of the work safety climate of the organisation with only a category difference for one factor, and that due to an increase in average score to the lowest score of the next category. In revising the brief version item content for reliability purposes, consideration would also need to be given to ensuring the same or a very similar work safety climate category profile for the factor items chosen.

This study looked beyond the statistical analysis of data that is often used when developing a brief version of a psychological scale and, in particular, this included reading level given that organisational scales of this kind may be used with workers, as in this study, some of whom had a language other than English as their original language. Analysis of the reading level required for items in the complete version of the NOSACQ – 50 showed that many of them required a reading level beyond that considered desirable for measures of this kind. Although reading level was considered in the choice of items for the brief version, the other non–statistical criterion of relevance for identifying important safety issues meant that the reading age of items in the brief version was only slightly lower than that in the complete version. However, other work safety climate questionnaires such as the PSC- 12 developed by Hall et al. (2010) also have reading levels above what is desirable for measures to be used with most work employees.

With respect to the relationship between the factors of the complete and brief versions of the scales and the dependent measures, similar significant correlations were found suggesting that the brief version could be similarly used to identify work safety climate in relation to important work outcome measures. As with the completed version, the brief version also found that the management factors were more highly correlated with some of the dependent measures such as physical health, in agreement with Beus et al. (2017) who found that management safety involvement and safety communication were consistently the highest-loading factors across the five samples of their study, suggesting that active management involvement in safety and open communication of safety issues are particularly meaningful indicators of an organisation's safety climate. The fact that rated behaviours and attitudes of management were found to be a dominant factor supports the notion that employee perceptions regarding the importance of safety are affected by the degree to which their managers are viewed as committed to safety. Thus, an important indicator of work safety as a priority is leadership's perceived commitment to safety (Brown & Holmes, 1986;

Cox & Cheyne, 2000; Dedobbeleer & Beland, 1991; Zohar, 2008). The results are also consistent with meta-analysis indicating that when predicting work injuries, management commitment to safety was the most robust predictor (Beus et al., 2010).

In the present study, correlations between factors for the brief version were similar to those of the complete version in so far as correlations between management factors were higher than those between co-worker factors. This may be a consequence of all ratings being made by Disability Support Workers who may have tended to rate managers according to an overall evaluation of them and without the detailed knowledge that they had of their own behaviours and attitudes, which resulted in lower correlations between the co-worker factors.

Although this study achieved a brief version of the complete NOSACQ-50 that had similar reliability, validity and practical usefulness, and that could be completed in approximately half the time of the complete version, there were some limitations. Firstly, the data collected was from only one type of organisation and it was only completed by DSW workers and not by managers. As already indicated, this latter limitation may account for the one common factor for the management scales. Managers need to complete the questionnaire to see if they show the opposite effect; that is, lower correlations between their own factors, and higher correlations amongst the co-worker factors indicating a similar better knowledge of themselves and a similar tendency to view DSWs in terms of a general overall view of their behaviours and attitudes.

Another limitation was the use of researchers to independently review the items and chose the questions they considered to be most practically useful. It would be beneficial to also have professional safety officers review the questions as these officers are likely to provide practical work-based insights beyond those of the researchers due to their experience in the field.

This study has provided important first steps towards the development of a usable shortened safety climate questionnaire that can be applied within organisations to monitor

work safety climate and indicate whether there are specific work safety issues needing to be addressed regarding the safety climate. However, lower than desirable reliability coefficients for some of the factors and a very slight difference in the profile of factors for the brief and complete versions of the NOSACQ-50 means that further research is needed to identify which, and how many questions are needed to provide similar results concerning reliability, validity and practical usefulness.

After developing a brief scale that satisfies the above criteria, the next step in research would be to apply this shortened version as well as the complete NOSACQ-50 in a variety of different organisations to determine the generalisability of the brief scale. A longitudinal study should also be conducted to determine whether the brief version can identify safety issues needing consideration and whether responses to its items can be used as a basis for implemented strategies that can successfully address those issues, or whether relevant sections of the complete version of the NOSACQ-50 might be needed to provide more detailed information in order to achieve this. Practical use of the brief scale in this way could also be facilitated by the addition of qualitative comments which allow respondents to more precisely indicate or give examples of the particular safety issue or issues that need to be addressed. Opportunities for comments would lengthen the questionnaire but this might not be by much if there were only one or two issues that require intervention and the additional information that such responses could provide might be essential to identify the real reason or reasons for safety related attitudes and / or behaviours that need to be improved.

Although the main benefit of a brief work safety climate measure might be as a monitoring tool for identifying emerging safety issues allowing timely intervention to prevent them from becoming critical, another benefit of a brief version would be for research purposes, and in particular, for investigating critical factors affecting work safety climate and its work safety outcomes. A brief version would allow researchers to incorporate additional

constructs to further investigate the work safety climate of an organisation (Huang et al., 2017).

In conclusion, this study has taken initial steps indicating the potential to create a brief version of the NOSACQ-50 that could have important practical benefits over the longer version, including its potential for monitoring an organisation's work safety climate and identifying possible safety issues and how they can be resolved before they become critical and result in stress and health related incidents and work accidents. It could also be of practical use for research purposes allowing factors affecting work safety climate and / or safety outcomes to be investigated within the practical time limits for research surveys. However, more research is needed to refine the content of a brief version in comparison to the complete version and to then investigate its potential practical use for these purposes.

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Appendix

Table A1

NOSACQ-50 pattern matrix for the 10-factor solution obtained from Principal Component extraction with an oblique rotation.

	NOSACQ-50 item	Component									
		1	2	3	4	5	6	7	8	9	10
	Factor Eigenvalue (% of variance)	16.5 33%	4.2 8.3%	2.6 5.2%	1.8 3.7%	1.7 3.3%	1.3 2.6%	1.2 2.4%	1.1 2.2%	1.1 2.1%	1.0 2.1%
Management safety priority, commitment and competence											
1#	Management encourages employees here to work in accordance with safety rules - even when the work schedule is tight									-.73	
2#	Management ensures that everyone receives the necessary information on safety									-.69	
3	Management looks the other way when someone is careless with safety §										-.44
4	Management places safety before production	.43									
5	Management accepts employees here taking risks when the work schedule is tight §										
6	We who work here have confidence in the management's ability to deal with safety	.58									
7#	Management ensures that safety problems discovered during safety rounds/evaluations are corrected immediately	.61									
8#	When a risk is detected, management ignores it without action§	.62									
9	Management lacks the ability to deal with safety properly§	.64									
Management safety empowerment											
10#	Management strives to design safety routines that are meaningful and actually work	.53									
11	Management makes sure that everyone can influence safety in their work environment	.53									
12	Management encourages employees here to participate in decisions which affect their safety	.58									
13	Management never considers employees' suggestions regarding safety§	.59									
14#	Management strives for everybody at the work site to have high competence concerning safety and risks	.50									
15	Management never asks employees for their opinions before making decisions regarding safety§	.71									
16#	Management involves employees in decisions regarding safety	.74									

	NOSACQ-50 item	1	2	3	4	5	6	7	8	9	10
Management safety justice											
17#	Management collects accurate information in accident investigations	.72									
18	Fear of sanctions (negative consequences) from management discourages employees here from reporting near-miss accidents§	.52									
19	Management listens carefully to all who have been involved in an accident	.64									
20#	Management looks for causes, not guilty persons, when an accident occurs	.67									
21	Management always blames employees for accidents §	.60									
22#	Management treats employees involved in an accident fairly	.61									
Workers' safety commitment											
23#	We who work here try hard together to achieve a high level of safety						-.46				
24	We who work here take joint responsibility to ensure that the workplace is always kept tidy						-.64				
25	We who work here do not care about each other's safety §						-.61				
26#	We who work here avoid tackling risks that are discovered §				-.75						
27#	We who work here help each other to work safely						-.56				
28	We who work here take no responsibility for each other's safety §						-.72				
Workers' safety priority and risk non-acceptance											
29	We who work here regard risks as unavoidable §								-.82		
30#	We who work here consider minor accidents to be a normal part of our daily work §								-.60		
31	We who work here accept dangerous behaviour as long as there are no accidents §			.61							
32#	We who work here break safety rules in order to complete work on time §										
33	We who work here never accept risk-taking even if the work schedule is tight							-.78			
34	We who work here consider that our work is unsuitable for cowards §			.88							
35#	We who work here accept risk-taking at work §			.48							

	NOSACQ-50 item	1	2	3	4	5	6	7	8	9	10
Peer safety communication learning, and trust in safety ability											
36#	We who work here try to find a solution if someone points out a safety problem		.62								
37	We who work here feel safe when working together		.77								
38#	We who work here have great trust in each other's ability to ensure safety		.77								
39#	We who work here learn from our experiences to prevent accidents		.68								
40	We who work here take each other's opinions and suggestions concerning safety seriously		.75								
41	We who work here seldom talk about safety §		.40								
42	We who work here always discuss safety issues when such issues come up		.67								
43#	We who work here can talk freely and openly about safety		.62								
Workers' trust in efficacy of safety systems											
44	We who work here consider that a good safety representative plays an important role in preventing accidents										
45	We who work here consider that safety rounds/evaluations have no effect on safety §										
46#	We who work here consider that safety training is good for preventing accidents					-.65					
47	We who work here consider early planning for safety as meaningless §					-.83					
48#	We who work here consider that safety rounds/evaluations help find serious hazards										
49#	We who work here consider safety training to be meaningless §					-.55					
50	We who work here consider it important to have clear-cut goals for safety					-.54					

Note: # Indicates item in Brief NOSACQ version § Negatively worded item

Table A2 *Detailed results for NOSACQ-50 item Cronbach's alpha deletions, correlations with health and wellbeing dependent measures, Flesch Kincaid Reading Grade Level, and researcher importance ratings.*

NOSACQ-50 item	α value when deleted	Correlation coefficients					Flesch Kincaid Reading Grade Level	Researcher Importance Ratings
		Personal Stress	Work Related Stress	Client Related Stress	Mental Health Score	Physical Health Score		
Management safety priority, commitment and competence								
1# Management encourages employees here to work in accordance with safety rules - even when the work schedule is tight	.86	-.31**	-.38**	-.26**	.30**	.24**	12.9	4
2# Management ensures that everyone receives the necessary information on safety	.85	-.33**	-.40**	-.23**	.29**	.16**	17.6	2
3 Management looks the other way when someone is careless with safety §	.87	-.23**	-.30**	-.28**	.24**	.17**	11.7	0
4 Management places safety before production	.87	-.33**	-.35**	-.19**	.26**	.26**	16.2	1
5 Management accepts employees here taking risks when the work schedule is tight §	.88	-.17**	-.24**	-.16**	.19**	.19**	9.4	1
6 We who work here have confidence in the management's ability to deal with safety	.85	-.34**	-.39**	-.26**	.28**	.26**	10.7	0
7# Management ensures that safety problems discovered during safety rounds/evaluations are corrected immediately	.86	-.25**	-.34**	-.25**	.20**	.21**	20.2	4
8# When a risk is detected, management ignores it without action §	.85	-.28**	-.35**	-.26**	.26**	.15**	10.1	0
9 Management lacks the ability to deal with safety properly §	.85	-.25**	-.34**	-.24**	.21**	.24**	13.0	1
Management safety empowerment								
10# Management strives to design safety routines that are meaningful and actually work	.88	-.29**	-.33**	-.23**	.29**	.20**	13.0	4
11 Management makes sure that everyone can influence safety in their work environment	.88	-.33**	-.40**	-.21**	.36**	.23**	13.0	0
12 Management encourages employees here to participate in decisions which affect their safety	.88	-.35**	-.40**	-.24**	.29**	.20**	17.6	1
13 Management never considers employees' suggestions regarding safety §	.89	-.26**	-.33**	-.19**	.21**	.15**	22.9	0
14# Management strives for everybody at the work site to have high competence concerning safety and risks	.88	-.36**	-.41**	-.26**	.21**	.15**	14.2	3
15 Management never asks employees for their opinions before making decisions regarding safety §	.88	-.32**	-.40**	-.33**	.24**	.20**	18.5	0
16# Management involves employees in decisions regarding safety	.88	-.33**	-.37**	-.31**	.24**	.24**	19.9	4

Correlation coefficients

NOSACQ-50 item	α value when deleted	Personal Stress	Work Related Stress	Client Related Stress	Mental Health Score	Physical Health Score	Flesch Kincaid Reading Grade Level	Researcher Importance Ratings
Management safety justice								
17# Management collects accurate information in accident investigations	.86	-.25**	-.29**	-.21**	.22**	.22**	24.4	4
18 Fear of sanctions (negative consequences) from management discourages employees here from reporting near-miss accidents §	.87	-.21**	-.34**	-.29**	.18**	.21***	17.7	2
19 Management listens carefully to all who have been involved in an accident	.83	-.36**	-.42**	-.27**	.27**	.25**	12.1	0
20# Management looks for causes, not guilty persons, when an accident occurs	.83	-.33**	-.39**	-.34**	.27**	.22**	11.7	5
21 Management always blames employees for accidents §	.84	-.33**	-.36**	-.22**	.21**	.14**	15.7	0
22# Management treats employees involved in an accident fairly	.84	-.37**	-.42**	-.30**	.29**	.25**	14.1	1
Workers' safety commitment								
23# We who work here try hard together to achieve a high level of safety	.66	-.22**	-.21**	-.12*	.16**	.08	8.3	4
24 We who work here take joint responsibility to ensure that the workplace is always kept tidy	.68	-.17**	-.17**	-.09	.14*	.10	10.4	1
25 We who work here do not care about each other's safety §	.66	-.19**	-.20**	-.17**	.07	.11*	6.7	0
26# We who work here avoid tackling risks that are discovered §	.75	-.17**	-.16**	-.12*	.10	.05	6.9	2
27# We who work here help each other to work safely	.66	-.15**	-.20**	-.16**	.14**	.05	4.7	4
28 We who work here take no responsibility for each other's safety §	.70	-.08	-.14*	-.16**	.13*	.10	10.7	1
Workers' safety priority and risk non-acceptance								
29 We who work here regard risks as unavoidable §	.72	-.28**	-.31**	-.21**	.23**	.17**	8.8	1
30# We who work here consider minor accidents to be a normal part of our daily work §	.69	-.30**	-.35**	-.33**	.31**	.19**	9	3
31 We who work here accept dangerous behaviour as long as there are no accidents§	.68	-.07	-.16**	-.21**	.13*	.02	9.9	0
32# We who work here break safety rules in order to complete work on time §	.68	-.28**	-.33**	-.31**	.27**	.15**	6.7	4
33 We who work here never accept risk-taking even if the work schedule is tight	.76	-.14**	-.18**	-.14*	.17**	.10	8.3	1
34 We who work here consider that our work is unsuitable for cowards §	.78	-.10	-.19**	-.25**	.10	.01	8.5	0
35# We who work here accept risk-taking at work §	.68	-.16**	-.24**	-.24**	.19**	.06	6.2	3

NOSACQ-50 item	α value when deleted	Correlation coefficients					Flesch Kincaid Reading Grade Level	Researcher Importance Ratings
		Personal Stress	Work-Related Stress	Client-Related Stress	Mental Health Score	Physical Health Score		
Peer safety communication learning, and trust in safety ability								
36# We who work here try to find a solution if someone points out a safety problem	.89	-.19**	-.18**	-.13*	.16**	.03	9	4
37 We who work here feel safe when working together	.88	-.25**	-.28**	-.21**	.16**	.16**	6	1
38# We who work here have great trust in each other's ability to ensure safety	.88	-.28**	-.34**	-.24**	.21**	.20**	9.1	1
39# We who work here learn from our experiences to prevent accidents	.88	-.14**	-.16**	-.11*	.04	.08	7.7	3
40 We who work here take each other's opinions and suggestions concerning safety seriously	.87	-.21**	-.24**	-.19**	.13*	.15**	14.3	1
41 We who work here seldom talk about safety§	.91	-.13*	-.10	-.07	.06	-.05	7.5	0
42 We who work here always discuss safety issues when such issues come up	.88	-.18**	-.18**	-.10	.12*	.09	8.4	0
43# We who work here can talk freely and openly about safety	.88	-.19**	-.22**	-.16**	.17**	.16**	8.7	3
Workers' trust in efficacy of safety systems								
44 We who work here consider that a good safety representative plays an important role in preventing accidents	.82	-.12*	-.14**	-.11*	.11*	.07	13.7	2
45 We who work here consider that safety rounds/evaluations have no effect on safety§	.82	-.18**	-.22**	-.16**	.16**	.14**	11.5	1
46# We who work here consider that safety training is good for preventing accidents	.79	-.16**	-.21**	-.21**	.13*	.16**	10.9	3
47 We who work here consider early planning for safety as meaningless §	.81	-.08	-.07	-.09	.03	.09	10.7	1
48# We who work here consider that safety rounds/evaluations help find serious hazards	.80	-.15**	-.19**	-.18**	.16**	.10	11.7	3
49# We who work here consider safety training to be meaningless §	.81	-.18**	-.18**	-.14	.15**	.08	10.1	1
50 We who work here consider it important to have clear-cut goals for safety	.81	-.16**	-.10	-.10	.10	.11*	9.2	2

Note. α = Cronbach's alpha; # Indicates item in Brief NOSACQ version § Negatively worded item; * p<.05 **p <.01