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The stage of change approach for implementing ergonomics advice – Translating research into practice

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ABSTRACT

The Stage of Change (SOC) approach has been proposed as a method to improve the implementation of ergonomics advice. However, despite evidence for its efficacy there is little evidence to suggest it has been adopted by ergonomics consultants. This paper investigates barriers and facilitators to the implementation, monitoring and effectiveness of ergonomics advice and the adoption of the SOC approach in a series of focus groups and a subsequent survey of members of the Human Factors Societies of Australia and New Zealand. A proposed SOC assessment tool developed for use by ergonomics practitioners is presented.

Findings from this study suggest the limited application of a SOC based approach to work-related musculoskeletal injury prevention by ergonomics practitioners is due to the absence of a suitable tool in the ergonomists' repertoire, the need for training in this approach, and their limited access to relevant research findings. The final translation of the SOC assessment tool into professional ergonomics practice will require accessible demonstration of its real-world usability to practitioners and the training of ergonomics practitioners in its application.

1. Introduction

Work-related musculoskeletal disorders (MSDs) are a major cost burden to individuals, businesses and society (National Research Council and the Institute of Medicine, 2001; Woolf and Pfleger, 2003). In the European Union MSDs are the most frequently reported health problem among workers (Eurofound, 2012). In the USA, over the preceding decade, they have accounted for more than one-third of all work-related injuries resulting in work absence (National Insitute for Occupational Safety and Health, 2004). While in Australia they are one of eight nationally recognised priority occupational diseases, accounting for total costs of more than $61.8 billion each year (Safe Work Australia, 2015).

The contribution of physical and psychosocial risk factors to the development of MSDs and the importance of implementing multifactorial interventions in their prevention is widely acknowledged (Silverstein and Clark, 2004; Westgaard and Winkel, 2011; Macdonald and Oakman, 2015). Although some successes in the implementation of MSD prevention strategies have been reported (Silverstein and Clark, 2004; Denis et al., 2008; Palmer et al., 2012) MSDs remain a significant workplace issue (Wells, 2009). Wells (2009) proposed that this limited success may be associated with low rates of implementation. In other words, there is a gap between the proposed interventions designed by ergonomists and those which are implemented by organisations (Rothmore et al., 2013; Oakman et al., 2016).

Issues related to implementation include the level of awareness of ergonomics issues (Whysall et al., 2004), organisational attitudes (Perrow, 1983), and political, social and contextual issues (Theberge and Neumann, 2010). While several authors have proposed methods to improve the effectiveness of ergonomics interventions in organisational settings these have been primarily researcher-driven with little consideration for the transferability of their findings into daily professional practice (Theberge and Neumann, 2010). As an example, while Broberg and Hermund (2004)

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proposed the concept of OHS consultants as "political reflective navigators" this requires the consultant to navigate complex organisational structures in order to pursue an agenda while others in the organisation pursue different agendas (Theberge and Neumann, 2010). While useful when the consultant is embedded within an organisation throughout a project it is less so for short-term, routine consulting practice where an evaluation of the implementation and effectiveness of the advice provided is scarce (Whysall et al., 2004).

Several authors have proposed the structuring of injury prevention advice according to behaviour-change principles as a means of improving the implementation and effectiveness of interventions designed to reduce the burden of musculoskeletal injuries (Haslam, 2002; Rothmore et al., 2015; Oakman et al., 2016). The most frequently applied behaviour change method in the workplace setting has been Prochaska and Di Clemente's (1982) Stage of Change (SOC) framework (Whysall et al., 2006; Village and Ostry, 2010; Rothmore et al., 2015). This was originally developed to improve the effectiveness of public health strategies such as smoking cessation (Prochaska et al., 1993) and reducing alcohol consumption (Heather et al., 2009). In such applications individual readiness to change is assessed and the intervention targeted at the individual only. However, in the workplace setting, while individual readiness to change is assessed, the intervention is aimed at the workgroup (Oakman et al., 2016). An additional layer of complexity arises with consideration of the organisational context where organisational readiness to change is reflected in the views of supervisors and managers on the nature and extent of workplace practices and changes (Haslam, 2002).

In the SOC framework, readiness to change is assessed using a short series of closed questions after which the respondent is assigned to one of five stages:

1. Pre-contemplation - unaware or unconcerned about workplace hazards
2. Contemplation - considering change but not yet ready to act
3. Preparation - intend to change in the near future
4. Action - made changes in the previous 6 months
5. Maintenance - made changes and are working to consolidate gains and avoid relapse

Once the stage of change has been determined, advice can be tailored accordingly. For example, those in the earlier stages will benefit from information on the risks and hazards associated with their current actions and behaviours in order to encourage progression to the later stages. Conversely, those in the more advanced stages will benefit from practical information on how to make, or maintain the changes already made.

Studies which have used this approach have shown benefits in the implementation (Rothmore et al., 2015) and outcomes (Whysall et al., 2006; Doda et al., 2015) of workplace interventions. In their UK study, Whysall et al. (2006) applied the SOC framework to pre-existing company plans. When evaluated four to six months after implementation they demonstrated some support for moving employees from pre-contemplation to action and reduced discomfort levels. These were maintained at 15 and 20-months follow-up (Shaw et al., 2007). In an Australian study, Rothmore et al. (2015) described the implementation of ergonomics interventions by the OHS managers of 25 workgroups who had been randomly assigned to receive either 'standard' ergonomics advice (i.e. advice based on ergonomics principles) or 'tailored' advice (i.e. advice based on ergonomics principles but prioritised according to the workgroup's SOC profile). An important difference from Whysall's study was the development of the interventions as an integrated component. This is more closely aligned with professional practice where consultants are engaged to identify problems and develop solutions. In this study all workgroup members completed an individual questionnaire to identify their SOC. The participating companies were subsequently visited by a single ergonomist (PR) in a 2–3 h site visit. Based on direct observations and discussions with employees and managers a report was prepared for the OHS manager. The report included details of the observations undertaken and the proposed changes. The companies were then randomly assigned to receive 'standard' or 'tailored' reports. Those companies which had been randomly assigned to receive tailored reports ($n = 12$) received additional information on the SOC profile of the workgroup as justification for the tailoring of the recommendations. This was not provided to companies in the standard group ($n = 13$). Where the SOC differed within the workgroup recommendations relevant to each stage present were provided. For example, in the description of the development of a tailored intervention described by Oakman et al. (2016) the distribution was as follows: six workers in contemplation/preparation stage, two in action, and 11 in maintenance. Consequently, the recommended changes took account of all three stages present in the workgroup. At 12 months follow-up, those who had received tailored advice had implemented the recommended changes at a significantly higher rate than those who had received standard ergonomics advice. Doda et al. (2015) subsequently analysed the associated health benefits. They reported that workers in companies which had received tailored advice were 40% less likely to report lower back pain than those in companies which had received standard ergonomics advice. Where the limited success in reducing the MSD burden has been associated with a failure to implement advice (Wells, 2009) and follow-up by consultants are scarce (Whysall et al., 2004) methods to improve the uptake are important. However, evidence that this approach has been adopted by health and safety practitioners in their routine practice is limited.

Potential barriers to the adoption of such an approach include the focus of ergonomics practitioners on the domain of practice in which they are most expert – the physical environment – and the lack of an assessment tool designed for use 'in the field.' The adoption of a method to frame and structure ergonomics advice according to behaviour-change theory will require a paradigm-shift. The process of translating research into practice has been proposed as intrinsically linked to the practice of ergonomics (Wilson, 2000) and to the future of the profession (Caple, 2008). Despite this, evidence suggests a 'disconnect' between researchers and practitioners which impedes the translation of research findings into practice (Salas, 2008).

The translation of research-based findings into professional practice will require an approach which bridges the 'research-practice gap' by both actively engaging ergonomics practitioners in research and improving the dissemination of findings.

Taking the above factors into account, the aims of this study were to translate the evidence-base for the SOC approach into professional practice by:

1. Identifying barriers and facilitators to the implementation, monitoring and effectiveness of ergonomics advice in preventing work-related MSDs
2. Identifying barriers and facilitators to the implementation of *behaviour-based* injury prevention advice by ergonomics practitioners
3. Obtaining the perspectives of ergonomics practitioners on the development and transferability of a behaviour-based assessment tool into professional practice

2. Methods

The engagement and participation of ergonomics practitioners was an integral part of the research process. They were engaged in a series of focus groups; contributed to the development of a proposed SOC assessment tool, and; participated in a survey of members of HFESA/HFESNZ.

2.1. Focus groups

Three focus groups were conducted with ergonomics practitioners purposely sampled from existing networks of the research team. In order to obtain a variety of perspectives and to assist in the translation of the study findings to the broad professional community they were conducted in three separate locations:

1. The University of Adelaide, Adelaide, South Australia
2. La Trobe University, Melbourne, Victoria
3. Massey University, Auckland, New Zealand

Each focus group, facilitated by the same researcher (PR), was between 45 and 60 min in length. A semi-structured interview schedule was used to guide the discussion, and participants were encouraged to elaborate on their own perspectives and experiences collectively and explore the areas interactively. A SOC assessment tool 'concept' was provided to participants for discussion and comment.

Audio recordings were transcribed prior to thematic analysis using the Framework Method (Ritchie and Lewis, 2003). The Framework Method is a systematic approach to data interpretation that identifies commonalities and differences in data before focussing on the identification of relationships and the development of themes.

Each focus group transcript was analysed separately prior to final synthesis. The findings from the focus groups were used to refine the SOC assessment tool and inform the development of a web-based survey.

2.2. Web-based survey

The survey of ergonomics practitioners, hosted on Survey Monkey, was developed according to Dillman's Tailored Design Method (Dillman and Smyth, 2007) which has been previously used for survey development in a similar population (Chung and Shorrock, 2011). Academics familiar with both ergonomics and research methodologies reviewed the survey for refinement. The survey was then piloted with 13 ergonomics practitioners who had participated in the focus groups. The majority were from a physiotherapy or occupational therapy background (n = 7, 54%).

The final version of the survey comprised 27 questions in four sections:

1. How do you develop and monitor the effectiveness of your advice?
2. The Stage of Change approach
3. Scope of practice
4. Demographics

All members of HFESA/HFESNZ (n = 713) were sent a link to the web-based survey by HFESA/HFESNZ. In order to encourage questionnaire completion, respondents were provided the option to skip questions where they chose. Follow-up reminders to complete the survey were sent at 7-day intervals (HFESA twice; HFESNZ once).

Survey responses were analysed using descriptive statistics in STATA 13.1 (StataCorp). The Wilcoxon-Mann-Whitney test (ordinal outcomes), Pearson's chi-square test (categorical outcomes) and Fisher's exact test (categorical outcomes with expected low frequencies) were used to identify statistically significant differences between internal and external consultants regarding the prioritisation, monitoring and evaluation of intervention advice.

2.3. The stage of change assessment tool

In section 2 of the survey, respondents were asked to view the proposed SOC assessment tool (Supplementary Material) and provide feedback.

3. Results

3.1. Focus groups

3.1.1. Participant characteristics

In total, 23 ergonomics practitioners participated in the focus groups – five in Adelaide, nine in Melbourne and nine in Auckland. Thirteen females and ten males participated with a mean age of 46 years (range = 26 to 58) and a mean of 16 years of experience (range = 1 to 30). Participants were employed in a range of sectors both public and private. The majority of participants were from a physiotherapy/occupational therapy background (n = 11, 48%).

3.1.2. Developing interventions

Participants consistently reported that when developing interventions they sought to target the advice according to the risk profile and attitudes of the managers and workers. Terms such as understanding the company "context" and being able to "sell" it to the audience were used. The importance of providing persuasive, targeted advice was emphasised:

> *"… getting buy-in or getting insight into why people don't perceive something as a risk and understanding that context for them because their world view will be very different to mine." (Melbourne Focus Group Participant)*

> *"At any given time you're only as good as your audience and the people you've been able to involve and engage." (Melbourne Focus Group Participant)*

Participants consistently described that the main method for prioritising advice was based on ease of implementation:

> *"Do the easy, the low hanging fruit, you do the easy things." (Auckland Focus Group Participant)*

3.1.3. Monitoring implementation

Participants consistently reported being unaware as to whether their advice was implemented. Main reasons described by participants were a lack of opportunity for follow-up and the very tight timeframes under which they were engaged. Participants reported a reluctance of employers to pay for formal monitoring or evaluation of intervention effectiveness:

> *"In a consulting role you get in, hit hard, and get out again. You don't have much involvement in terms of what a program might achieve." (Melbourne Focus Group Participant)*

> *"You don't necessarily know and at the end of the day you've provided recommendations and sometimes you don't get much say beyond that, do you?" (Auckland Focus Group Participant)*

Other participants relied on informal processes to identify success:

"Often you unlock a champion, or someone there that will keep you informed, as well as the progress of, you know, the changes that have been implemented and how they are working." (Auckland Focus Group Participant)

In addition, some participants considered an 'a priori' lack of client intention to act was present:

"Companies might commission a review by a consultant – but they won't do it … they just want to be seen to be doing something." (Adelaide Focus Group Participant)

3.1.4. Evaluating effectiveness

Given the difficulties monitoring implementation, a consistent theme emerged across all three focus groups that consultants were unsure about the effectiveness of their advice. Participants considered this was due to the nature of consulting contracts and the reluctance of employers to pay for formal evaluation following the intervention:

"As an external consultant usually you have very little feedback let alone opportunities for investigating the effectiveness of the outcome." (Adelaide Focus Group Participant)

"Companies don't want to know if something is not working." (Auckland Focus Group Participant)

Consultants tended to rely on informal measures such as repeat business:

"They call you back if they are happy with you." (Adelaide Focus Group Participant)

Repeat business was also used by some as an opportunity to evaluate previously provided advice as described by one participant:

"So you get asked back and then you can check on the other things you have done." (Auckland Focus Group Participant)

A further theme also emerged suggesting that consultants may not be aware of suitable evaluation methods – for example there may be an over-reliance on the use of lagging indicators such as claim numbers and lost hours. While useful for economic evaluation, they are reliant on long-term follow-up and overlook the potential for leading indicators such as the number of changes which have been implemented:

"I don't think a lot of practitioners have good evaluation research skills." (Melbourne Focus Group Participant)

Overall, participants reported they had low levels of influence over whether their advice was implemented and limited awareness of its effectiveness:

"From a consultancy point of view, you make an intervention, it might be successful, you don't know, you don't hear." (Auckland Focus Group Member)

3.1.5. Ergonomics tools

Participants in each of the focus groups identified a wide range of ergonomics tools they commonly used in practice. The tools included both physical and psychosocial assessment methods. In describing how consultants made choices about their tools a range of responses were provided. Some participants focussed on the scientific rigour of methods:

"Validation, I think, is an important thing." (Auckland Focus Group Participant)

Others, adopted a more pragmatic approach:

"It's because that's what you learnt." (Auckland Focus Group Participant)

Irrespective of competing reasons, participants identified the main characteristics required of field-based tools were ease-of-use and the ability to add impact to the recommendations.

Participants considered that adoption of the SOC approach by practitioners would depend on whether this approach would enhance the quality of their services and improve the relevance of their reporting:

"I think it will be very acceptable to people if they see a clear advantage to being able to classify people in order to channel your recommendations instead of just writing, you know, two pages of recommendations." (Adelaide Focus Group Participant)

3.2. Web based survey

3.2.1. Participant characteristics

A total of 219 survey responses were obtained from 636 HFESA and 77 HFESNZ members. The overall response rate was 31%. In order to encourage completion of the web-based survey responses to all questions were not mandatory. Therefore, response rates to each question varied from 219 in places where respondents chose not to provide an answer (range: 165–219).

Participants' background was mostly physiotherapy or occupational therapy (n = 85, 39%). Most participants were members of HFESA (n = 150, 69%) compared to HFESNZ (n = 12, 6%). Slightly more females participated (n = 95, 43%) than male (n = 73, 33%). Participants' mean age was 49 years (SD = 11, range = 24 to 80), with a mean of 18 years practice in the occupational health and ergonomics field (SD = 10, range = 2 to 45). Participants worked in both external (n = 74, 34%) and internal (n = 85, 39%) consulting roles. Participants' work was primarily focussed in the physical domain of ergonomics practice (Fig. 1) with a median of 60% of their time (IQR = 33%–80%), much higher than time spent in the organisational (median = 20%, IQR = 15%–40%) or cognitive domains (median = 15%, IQR = 10%–25%).

Participants practiced ergonomics across all industries including education and training (n = 89, 41%), transport, postal and warehousing (n = 95, 43%), administrative and support services (n = 106, 48%), manufacturing (n = 108, 49%), or health care and social assistance (n = 115, 53%). Participants primarily practiced in the application areas of musculoskeletal disorders (n = 148, 68%) and safety and health (n = 146, 67%).

3.2.2. Advice provided to clients

Table 1 provides a summary of survey responses on the prioritising, implementation and effectiveness of advice provided to clients.

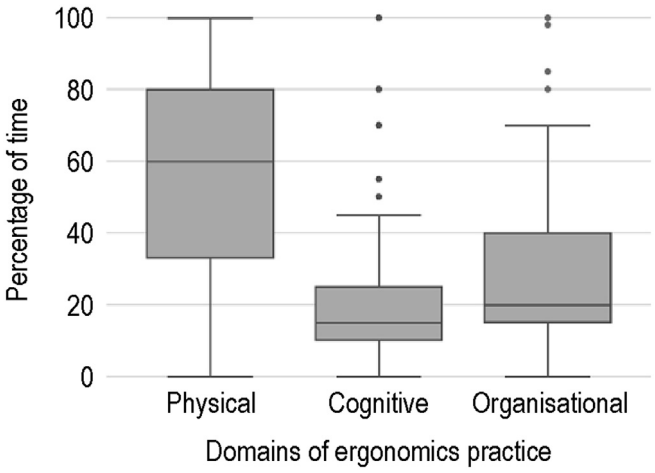

Fig. 1. Percentage of participants' time spent in each domain of ergonomics practice. Response not provided for n = 48.

Participants indicated that when developing advice for clients they undertook a prioritisation process (n = 187, 85% always or usually), regardless of whether they were internal or external consultants (p = 0.119). Prioritisation of advice was undertaken using three approaches:

- Risk management approach (n = 158, 72%) - where recommendations are prioritised according the likely risk of injury
- Hierarchy of controls approach (n = 98, 45%) - where recommendations are prioritised according to the effectiveness of the control measures, and
- Perceived ease of implementation (n = 79, 36%) - where recommendations are prioritised according to level of difficulty associated with their implementation

Additionally, some participants reported taking into account the costs involved, a point consistent with the findings from the focus group discussions.

Internal consultants were more likely to know whether the advice they provided was implemented, compared to external consultants (internal: n = 50, 59% always or usually; external: n = 33, 45%; p = 0.021). While internal consultants monitored implementation as part of their role within the organisation (n = 51, 60%), external consultants gathered information regarding implementation by either following up with the client directly (n = 44, 60%) or receiving unsolicited feedback from the client (n = 19, 26%). Where external consultants reported specific barriers to monitoring the implementation and effectiveness of their advice, 20% (n = 44) reported this was related to the nature of their external role, 18% (n = 39) reported it was not part of the brief, and 16% (n = 34) reported that the company did not supply the information. In total, 35% (n = 77) of consultants (internal and external) experienced difficultly with monitoring the implementation of their advice due to companies not providing relevant information.

Evaluation of intervention effectiveness was more likely to be done by internal consultants (internal: n = 61, 72%; external: n = 32, 43%; p < 0.001). External consultants were reliant on following up with the client directly (n = 44, 60%) or receiving unsolicited feedback (n = 15, 20%), while internal consultants monitored effectiveness as part of their role within the organisation (n = 51, 60%). Both internal and external consultants reported the cost to the company (internal: n = 29, 13%; external: n = 37, 17%) and disinterest by the company (internal: n = 41, 19%; external: n = 45, 21%) as barriers to monitoring intervention effectiveness.

3.3. The stage of change assessment tool

Table 2 provides a summary of survey responses to the behaviour change process and the SOC Assessment Tool provided in the survey.

Many survey participants were not aware of any behaviour change models (n = 98, 45%). Of those respondents with an awareness of behaviour change models, the Prochaska and Di Clemente (1982) Stage of Change model was the most well-known (n = 80, 37%).

After viewing the proposed SOC assessment tool itself (Supplementary Material), 21% (n = 45) of survey participants reported that the application of behaviour change principles was outside their current area of expertise. Additionally, participants reported that the absence of readily available published research in this area (n = 44, 20%) demonstrating practical application (n = 23, 11%) were barriers to their use of such a tool.

The primary facilitator to its use was the availability of an easy to use tool, with clear instructions, designed for use in the field (n = 130, 59%). Other important factors included access to research demonstrating the practical application of the tool (n = 111, 51%) and training (n = 90, 41%). Few participants indicated they would be unlikely to use the tool (n = 38, 17%), with the majority either likely (n = 80, 37%) or uncertain (n = 57, 26%).

4. Discussion

This paper has investigated barriers and facilitators to the implementation and monitoring of ergonomics advice and the use of behaviour-based tools, such as SOC, during advice development. Our results provide further support to the findings of Whysall et al. (2004), Theberge and Neumann (2010), Broberg and Hermund (2004) and Neumann et al. (2010), who have all identified the need to design interventions sensitive to the drivers for organisational change. A key difference in our study was the intent to integrate the research process with the development of a SOC assessment tool for use in the field.

4.1. Barriers and facilitators to the implementation and monitoring of ergonomics advice

Many of the themes identified qualitatively were found to be broadly prevalent through the web based survey. In our study, consultants reported that they were generally unaware whether the advice they had provided was implemented by the client or whether it had been effective. Reasons for this included the lack of feedback provided by the client, the very tight timeframes and cost-constraints associated with private consulting contracts. This is consistent with previously reported findings by Whysall et al. (2004) regarding ergonomics consultants in the UK. In our study, consultants tended to rely on informal feedback from clients and the assumption that repeat business was an indicator that advice previously provided had been effective. However, disinterest and a lack of motivation on the part of companies to implement change were also reported.

Understanding organisational and individual commitment, motivation and attitudes are important factors in the implementation of interventions (Nielsen et al., 2006). The focus group participants emphasised the importance of prioritising their advice according to ease of implementation and the attitudes of managers and workers. However, this was less evident in the survey findings where respondents reported the risk management approach as the predominant means of prioritising advice. These differences may

Table 1
Prioritising and monitoring the implementation and effectiveness of advice to clients.

	Consultant role		p value	Total[a] (%)
	External (%)	Internal (%)		
Total participants	74	85		219
Consultant prioritises the advice provided:			0.119[e]	
Always	30 (40.5)	42 (49.4)		98 (44.7)
Usually	34 (45.9)	39 (45.9)		89 (40.6)
Sometimes	8 (10.8)	3 (3.5)		15 (6.8)
Seldom	0 (0.0)	1 (1.2)		1 (0.5)
Never	2 (2.7)	0 (0.0)		2 (0.9)
Not provided	0 (0.0)	0 (0.0)		14 (6.4)
Advice is prioritised by:[b]				
Risk management approach	55 (25.1)	69 (31.5)	0.463[f]	158 (72.1)
Hierarchy of controls approach	36 (16.4)	43 (19.6)	0.941[f]	98 (44.7)
Ease of implementation	31 (14.2)	36 (16.4)	0.929[f]	79 (36.1)
Other (specified)	17 (7.8)	19 (8.7)	–	47 (21.5)
Not provided	0 (0.0)	0 (0.0)	–	15 (6.8)
Consultant knows whether the advice provided is implemented:			0.021[e]	
Always	2 (2.7)	14 (16.5)		18 (8.2)
Usually	31 (41.9)	36 (42.4)		92 (42.0)
Sometimes	33 (44.6)	28 (32.9)		88 (40.2)
Seldom	8 (10.8)	7 (8.2)		20 (9.1)
Never	0 (0.0)	0 (0.0)		0 (0.0)
Not provided	0 (0.0)	0 (0.0)		1 (0.5)
Implementation known by:			>0.001[f]	
Unsolicited feedback from the client	19 (25.7)	6 (7.1)		36 (16.4)
Follow up directly with the client	44 (59.5)	22 (25.9)		86 (39.3)
Monitor as an internal consultant[d]	7 (9.5)	51 (60.0)		69 (31.5)
Other	4 (5.4)	6 (7.1)		12 (5.5)
Not provided	0 (0.0)	0 (0.0)		16 (7.3)
Barriers to knowing:[b,c]				
Not part of the brief	39 (17.8)	16 (7.3)	>0.001[f]	73 (33.3)
Very difficult as an external consultant[#]	44 (20.1)	13 (5.9)	>0.001[f]	73 (33.3)
Company does not provide the information	34 (15.5)	29 (13.2)	0.442[f]	77 (35.2)
Unsure how to do this	1 (0.5)	5 (2.3)	0.116[g]	6 (2.7)
Other (specified)	14 (6.4)	29 (13.2)	–	54 (24.7)
Not provided	0 (0.0)	2 (0.9)	–	18 (8.2)
Consultant monitors the intervention's effectiveness:			>0.001[e]	
Always	7 (9.5)	17 (20.0)		32 (14.6)
Usually	25 (33.8)	44 (51.8)		86 (39.3)
Sometimes	27 (36.5)	22 (25.9)		61 (27.9)
Seldom	14 (18.9)	2 (2.4)		24 (11.0)
Never	1 (1.4)	0 (0.0)		1 (0.5)
Not provided	0 (0.0)	0 (0.0)		15 (6.8)
Monitored by:			>0.001[f]	
Unsolicited feedback from the client	15 (20.3)	6 (7.1)		26 (11.9)
Follow up directly with the client	44 (59.5)	22 (25.9)		90 (41.1)
Monitor as an internal consultant[#]	6 (8.1)	51 (60.0)		65 (29.7)
Other (specified)	0 (0.0)	0 (0.0)		19 (8.7)
Not provided	8 (10.8)	6 (7.1)		18 (8.2)
Barriers to monitoring:[b,c]				
Cost to company	37 (16.9)	29 (13.2)	0.144[f]	79 (36.1)
Company disinterest	45 (20.5)	41 (18.7)	0.940[f]	109 (49.8)
Not part of the brief	43 (19.6)	18 (8.2)	>0.001[f]	84 (38.4)
Very difficult as an external consultant[d]	40 (18.3)	10 (4.6)	>0.001[f]	66 (30.1)
Unsure how to do this	1 (0.5)	3 (1.4)	0.619[g]	5 (2.3)
Other (specified)	5 (2.3)	24 (11.0)	–	36 (16.4)
Not provided	0 (0.0)	3 (1.4)	–	23 (10.5)

[a] Total includes 74 external consultants, 85 internal consultants, 13 participants who indicated their role as 'other', and 47 participants who did not report their consultant role.
[b] Multiple answers to the question were possible, therefore percentages do not add to 100.
[c] Participants were asked about barriers only if they indicated they did not always do the activity.
[d] While the primary role of the participant was as an internal consultant, they may have had additional employment as an external consultant, and vice versa.
[e] P value determined using Wilcoxon-Mann-Whitney test.
[f] P value determined using Chi-Square test.
[g] P value determined using Fishers Exact test.

be due to methodological issues (i.e. direct discussion versus web-based survey) or related to demographic differences between the groups. However, an important finding was that consideration of these factors was not formally incorporated in the development of advice in either group.

Having identified the issue thematically in the focus group work, the web-survey indicated that acquiring knowledge of the implementation and effectiveness of the advice provided was broadly problematic for practitioners. This was particularly so for external consultants. Even though nearly 60% of external consultants reported following up directly with clients, they also reported the difficulties associated with working externally as the principle

Table 2
Knowledge of behaviour change models and perceptions of the proposed Stage of Change assessment tool.

	Number (%)
Total participants	219 (100.0)
Behaviour change models the consultant is aware of:[a]	
Value-expectancy models (Ajzen and Fishbein, 1980; Rogers, 1983)	35 (16.0)
Contextual or environmental models (DeJoy and Southern, 1993)	32 (14.6)
Behaviour change models (Prochaska and Di Clemente, 1982)	80 (36.5)
None of these	98 (44.7)
Other	18 (8.2)
Not provided	23 (10.5)
Barriers to use of the proposed Stage of Change assessment tool:[a]	
Published research in this area is not readily available	44 (20.1)
Published research in this area is inconclusive	21 (9.6)
Published research in this area has no practical application	23 (10.5)
The application of behaviour-change principles is outside the consultant's area of expertise	45 (20.5)
This is not relevant to the consultant's area of professional practice	21 (9.6)
Other	56 (25.6)
Not provided	51 (23.3)
Facilitators to use of the proposed Stage of Change assessment tool:[a]	
Access to published research in this area	65 (29.7)
Published research showing practical application	111 (50.7)
An easy to use tool designed for use in the field with instructions for use	130 (59.4)
Training in the application of this method	90 (41.1)
Other	22 (10.0)
Not provided	46 (21.0)
Likelihood of using the proposed Stage of Change assessment tool provided:	
Very unlikely	14 (6.4)
Somewhat unlikely	24 (11.0)
Unsure	57 (26.0)
Somewhat likely	57 (26.0)
Very likely	23 (10.5)
Not provided	44 (20.1)

[a] Multiple answers to the question were possible, therefore percentages do not add to 100.

barrier, along with the lack of information provided and disinterest by the company. This is consistent with the findings of Trevelyan and Haslam (2001) and from the focus groups where it was reported by some that "companies don't want to know if something is not working." Similarly, in dynamic work environments it is not unusual for company priorities, or personnel, to change (Pedersen et al., 2012), which can exacerbate difficulties in obtaining sufficient information to allow for an evaluation of intervention effectiveness.

4.2. Barriers and facilitators to the implementation of behaviour-based ergonomics advice

In our study, consultants reported paying little attention to the change process associated with workplace interventions. This may be because the majority of respondents focussed on the physical domain of ergonomics, with a large proportion noting that the application of behavioural change strategies lay outside their area of expertise. Many respondents were not aware of behaviour change methods. This finding supports those of Whysall et al. (2004) who reported, in their UK sample of 14 ergonomics consultants, that the assessment of physical factors dominated ergonomics practice. A similar focus on physical factors was reported by Wells et al. (2013) in a study of 21 Canadian ergonomists' use of workplace assessment methods. Interestingly, in their study, while ergonomists mentioned psychosocial factors during interviews they did not mention using, or having the need for, any psychosocial assessment tools (Wells et al., 2013). Paradoxically, however, they reported a consistent theme of the need to convince organisations to make changes.

One of the strongest barriers to the incorporation of research findings into professional practice was identified as the difficulty in obtaining access to journal articles and a lack of clearly stated implications for practice – i.e. the research-practice gap. This finding parallels the results of a cross-sectional survey of 587 practitioners from 46 countries conducted by Chung and Shorrock (2011). In their study, respondents indicated that the difficulty in obtaining access to journal articles was associated with limited access to databases which are routinely used in academia (e.g. Scopus, PubMed). This was due to subscription constraints, time, and the skills required to browse, retrieve and evaluate published articles. Even when journal articles were obtained, despite these barriers, a lack of practical relevance served as a disincentive to further searches.

Anderson et al. (2001) suggested the 'disconnect' between researchers and practitioners was a result of competing priorities. Practitioners working in dynamic work environments with significant time constraints may focus on topical and popular methods, irrespective of theoretical validity. Conversely, researchers may focus on research in more easily controlled environments, such as simulated environments or laboratories, in order to achieve a significant result (and a publishable peer reviewed paper) even if the practical relevance is limited (Wilson, 2000). In order to translate research findings into practice, and bridge this research-practitioner gap, active engagement of practitioners during research is critical to ensure clear relevance for professional practice (Rothmore et al., 2013).

Despite evidence for the effectiveness of the SOC approach as a means to improve the implementation of ergonomics advice (Rothmore et al., 2015) and the health benefits for workers (Whysall et al., 2006; Shaw et al., 2007; Doda et al., 2015) adoption by practitioners is limited. We propose that this lack of adoption is related to the issues associated with the research-practice gap, as highlighted by our survey respondents.

Previous studies of ergonomics practice have highlighted the difficulties associated with the formal monitoring of the

implementation and effectiveness of the advice provided to organisations (Whysall et al., 2004; Wells et al., 2013) and our findings support this. While participants in the study by Wells et al. (2013) mentioned the need to "convince" organisations to implement their recommendations, participants in the current study mentioned the need to "sell" their advice. Irrespective of the term, consultants recognise the need to frame their advice to maximise its uptake.

4.3. The proposed stage of change assessment tool

The SOC tool 'concept' discussed in the focus group was designed for research application and had been previously used by Rothmore et al. (2015). Modifications to this tool, in the present study, were made based on comments provided by the focus groups. The intent was to develop an easy to use tool (with instructions) designed for practitioners working in the field.

Survey respondents suggested they would be likely to adopt the SOC assessment tool (Supplementary Material). This is of particular significance as most respondents were working in the area of physical ergonomics and considered that the application of behaviour-change principles was outside their area of expertise. This suggests that the principal barrier to the adoption of more holistic practice may be the lack of a clear, practical 'user friendly' tool in the ergonomists' repertoire.

The structuring of injury prevention advice according to behaviour-change principles was originally proposed by Haslam (2002), with evidence relating to its effectiveness also published by Whysall et al. (2006) and Village and Ostry (2010). However, the practical application of these studies was limited as the methods used were not reflective of professional practice. In the study by Whysall et al. (2006) the SOC approach was applied to pre-existing company plans while Village and Ostry (2010) demonstrated its ability to identify worker readiness to change as a prelude to developing an intervention. More recently, Rothmore et al. (2015) and Doda et al. (2015) have demonstrated the potential benefits of this approach in a study more closely aligned with professional practice where recommendations were developed following direct observation and evaluation of the work environment.

5. Strengths and weaknesses of this research

We have sought to bridge the research-practice gap by engaging ergonomics practitioners in all facets of the research process: seeking their views in focus groups; using their feedback during the development of web-based survey tools for the broader profession; inviting the participation of members of HFESA/HFESNZ; seeking their comments and feedback on a proposed SOC assessment tool designed for use in the field, and; exploring barriers and facilitators to its use.

Whilst we sought to engage with consultants as broadly as possible we elected to focus on members of HFESA/HFESNZ. These organisations were chosen because their members are drawn from a wide variety of professional backgrounds and who practice in a range of domains. Although the response rate of 31% is modest, this figure is based on all 713 members of HFESA/HFESNZ. We sought to elicit responses only from those who practice primarily in the area of MSD prevention (which would not include all members). As a result it is likely that our response rate represents a higher percentage of those who practice primarily in this area, but we are unable to quantify this. However, this compares favourably with a previous survey of ergonomists by Chung and Shorrock (2011) where the reported participation rate was 9%. There are also other large professional organisations whose members may have a specific interest in the prevention of work-related MSDs (e.g. Physiotherapy, Occupational Therapy and Occupational Safety and Health). However, as broad professional associations, we considered that the proportion of members in Australia and NZ with a specific interest in the development of interventions to prevent work-related MSDs would be low.

We have reported that a majority (53%) of the survey respondents indicated a level of willingness to incorporate the SOC tool in their current practice (likely, 37%; unsure 26%). While this feedback may reflect a tendency to respond positively to new information (i.e. a social desirability bias) this is an inherent limitation to all surveys of this type.

6. Conclusions

The SOC approach has been proposed as a method to improve the implementation of ergonomics advice. However, despite evidence for its efficacy there is little evidence to suggest it has been adopted by professional consultants. The translation of research evidence into professional practice outlined in this paper relied heavily on engagement with ergonomics practitioners with the intent of developing a draft SOC assessment tool designed for their use. As a method for improving the implementation of ergonomics advice we suggest that it provides consultants with a method to interpret the change process in complex organisational settings where they are only visitors. Developing technical solutions may be the least of the issues faced by ergonomics consultants. The greater issue is the implementation of the advice provided and methods to improve this are needed. Findings from this study suggest the limited application of a SOC based approach to work-related musculoskeletal injury prevention by professional consultants is due to a suitable tool not being available, the need for training in its application and the lack of access to relevant research findings. We have sought to bridge the research-practice gap by involving ergonomics practitioners in all facets of the research - with encouraging results. The final translation of the SOC assessment tool into professional ergonomics practice will require further dissemination and instruction in the use of the assessment tool. The subsequent demonstration of its real-world usability will further support its uptake.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.apergo.2016.08.033.

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