“Taking action for the Reef?”—Australians do not connect Reef conservation with individual climate-related actions

Angela J. Dean PhD1,2,3 | Robyn E. Gulliver PhD4 | Kerrie A. Wilson PhD1

1 Centre for the Environment, Institute for Future Environments, Queensland University of Technology, Brisbane, Queensland, Australia
2 School of Biology and Environmental Science, Queensland University of Technology, Brisbane, Queensland, Australia
3 School of Psychology, The University of Queensland, St Lucia, Australia
4 Centre for Biodiversity and Conservation Science, School of Biological Sciences, The University of Queensland, St Lucia, Australia

Correspondence
Angela J. Dean, Centre for the Environment, Institute for Future Environments, Queensland University of Technology, 2 George St, Brisbane, QLD 4001, Australia. Email: angela.dean@qut.edu.au

Abstract
Climate change is the most significant threat to the Great Barrier Reef (GBR). While Australians express appreciation and concern for the GBR, it is not clear whether they connect climate-related action with reef conservation. An online survey of 4,285 Australians asked “…what types of actions could people like you do that would be helpful for the GBR?” Only 4.1% mentioned a specific action related to mitigating climate change; another 3.8% mentioned climate change but no specific action. The most common responses related to reducing plastic pollution (25.6%). These findings demonstrate that most Australians have poor capacity to identify individual climate-related actions as helpful for reef protection, and that generic calls to action—such as “protect the reef”—are unlikely to elicit climate-related actions. As such, reef conservation initiatives must explicitly promote actions—in the home and in society—that reduce emissions and support the transition to a low carbon society.

KEYWORDS
behavior change, climate mitigation, Great Barrier Reef, reef conservation, plastic, political orientation, pollution, private-sphere behavior, public-sphere behavior, top of mind awareness

1 | INTRODUCTION

1.1 | Importance of climate action for the Great Barrier reef

Coral reefs are among the world’s most endangered ecosystems (Hoegh-Guldberg, Poloczanska, Skirving, & Dove, 2017; Hughes, Graham, Jackson, Mumby, & Steneck, 2010). The Great Barrier Reef (GBR) is the world’s largest coral reef ecosystem: the “outstanding universal value” and importance of the GBR is the basis of its World Heritage listing (Great Barrier Reef Marine Park Authority, 2019). However, the health of the GBR is seriously threatened. Between 1985 and 2012, the GBR lost 25–50% of its coral cover (De’ath, Fabricius, Sweatman, & Puotinen, 2012). Since this time, the GBR has experienced record-breaking marine heatwaves and mass coral bleaching events, which resulted in high rates of coral mortality (Hughes, Kerry, & Baird, 2018). During summer of 2020, the GBR experienced a third mass coral bleaching event within the GBR in the last 5 years (Hughes & Pratchett, 2020). While there are many threats to reef health—including poor water quality stemming from land-based runoff, cyclones, and coral predation by crown-of-thorns starfish (COTS) (Great Barrier Reef Marine Park Authority, 2019)—the increasing frequency and severity of bleaching events means that...
anthropogenic climate change is now considered the most significant threat to the GBR (Commonwealth of Australia, 2018; Great Barrier Reef Marine Park Authority, 2019; Hughes et al., 2018; Hughes, Kerry, & Álvarez-Noriega, 2017). The health of GBR requires “urgent and rapid action to reduce global warming” (Hughes et al., 2017).

### 1.2 Governance and social dimensions

The GBR is jointly managed by Australian government agencies, including The Great Barrier Reef Marine Park Authority (GBRMPA), several Queensland Government (state) agencies, and other stakeholders (Morrison, 2017). The Reef 2050 Long-Term Sustainability Plan was developed in 2015 to protect the GBR’s Outstanding Universal Values in the face of diverse threats, and was revised in 2018 to strengthen the emphasis on climate change (Commonwealth of Australia, 2018). In 2017, the Reef Blueprint for Resilience proposed ten initiatives promoting resilience of the GBR in the face of climate change. While these agencies do not lead national responses to climate change (which falls under the responsibility of other departments), they do recommend “greater prominence to benefits of reducing emissions for the Reef” and “uptake of renewable energy and emission reduction activities” (Great Barrier Reef Marine Park Authority, 2017, p. 21).

Social research conducted in 2008 indicates that while most Australians endorsed statements of concern about climate change and the GBR, the actual uptake of climate-related behaviors was lower (Sutton & Tobin, 2011). Since this time, multiple mass coral bleaching events have generated significant media attention about climate risks to the GBR (Eagle, Hay, & Low, 2018; Hannam, 2016) and community concern about reef health and climate change (Curnock et al., 2019; Marshall et al., 2019). Surveys of residents of GBR catchments report that perceptions of climate change threat were related to uptake of waste-related behaviors (Goldberg et al., 2018), and recent polls indicate that Australians are increasingly likely to agree with statements indicating concern about climate change and support for decarbonization (Ipsos, 2018; Merzian, Quicke, Bennett, Campbell, & Swann, 2019). However, it is not clear whether recent bleaching events and reported concern corresponds to a national readiness to adopt climate-related actions to support the GBR.

### 1.3 Addressing climate change requires both private- and public-sphere actions

There are many individual actions that can support emissions reduction and decarbonization. Typologies of pro-environmental behavior distinguish between private-sphere and public-sphere actions (Larson, Stedman, Cooper, & Decker, 2015; Stern, 2000). Private-sphere actions involve reducing emissions in daily life, such as turning lights off, choosing renewable power sources, or choosing alternatives to private car use (Carmen & Zint, 2020; Climate Council, 2018; Hawken, 2017; Wynes & Nicholas, 2017) (Figure 1). In contrast, public-sphere behaviors include actions where individuals seek to influence public policy through petitioning governments, donating to advocacy organizations, or participating in activism (Doherty & Webler, 2016; Hofman, Hughes, & Walters, 2020; Whitmarsh, Seyfang, & O’Neill, 2011; Wynes...
 Awareness of available actions is a necessary precursor to action

Diverse factors influence adoption of climate-related actions. These include (i) psychological factors, e.g., personal values and identity, threat awareness, sense of responsibility, the perceived behavior of others (social norms), and perceptions about the action; (ii) contextual factors that influence the opportunity to perform an action, e.g., availability of solar technologies, incentives; (iii) personal capacity to perform the action, including access to time and resources; and (iv) habits (Bouman et al., 2020; Klockner, 2013; Stern, 2000; Vainio, Pulkka, Paloniemi, Varho, & Tapio, 2020; van Valkengoed & Steg, 2019; Wolske, Gillingham, & Schultz, 2020). A distal but necessary precursor for taking action is knowing what actions can be performed to achieve a goal, sometimes referred to as “procedural knowledge” (Kaiser & Fuhrer, 2003). Research suggests that procedural learning is more important than factual learning at promoting conservation behaviors (Dean, Church, Loder, Fielding, & Wilson, 2018). Within this context, the ability to identify or recall a specific reef protection action is a necessary cognitive step that precedes action (Kaiser & Fuhrer, 2003).

Gauging propensity for conservation action

It is increasingly recognized that solving conservation challenges needs to consider human behavior (Cinner, 2018; Nilsson, Fielding, & Dean, 2020; Reddy et al., 2017). For conservation action to occur, the need for action and appropriate behavior must come to mind in real-world contexts, where actions are executed (or not) within the complex practices and settings of everyday life (Hargreaves, 2011; Hess, Samuel, & Burger, 2018). However, the best methods to ascertain this are not well established. Much behavioral research assesses intentions to perform relevant behaviors by asking participants to respond to a list of statements or actions. Such methods may inadvertently overestimate actual awareness and behavior due to people’s tendency to agree with statements presented to them (acquiescence bias) or to provide socially desirable responses (social desirability bias) (Juvan & Dolnicar, 2016; Waller, McCaffery, & Wardle, 2004; Whitmarsh, 2008). This highlights the need to gauge propensity for action using different methods.

We use the GBR—an iconic ecosystem that is highly valued by the Australian community—as a case study to address this issue. We assess whether Australians associate reef protection with individual climate-related actions using unprompted questions, referred to as “top-of-mind awareness” (Brochado, da Silva, & LaPlaca, 2015; Laurent, Kapferer, & Roussel, 1995; Romaniuk, Wight, & Faulkner, 2017). Research suggests that open-ended, unprompted questions are less likely to be affected by acquiescence or social desirability bias (Juvan & Dolnicar, 2016; Waller et al., 2004; Whitmarsh, 2008). As such, they provide a more robust indicator of actual understanding (Liao, Yang, & Zhong, 2019; Whitmarsh, 2008) and behavior that is likely to occur in everyday life (McKercher, Prideaux, Cheung, & Law, 2010; Woodside & Lysonski, 1989; Yun & Berry, 2018), especially in response to generic rallying calls to “protect the reef.” Specifically, our research questions are: (i) what proportion of Australians are able to identify climate-related actions (either private- or public-sphere) when asked unprompted what they can do for the GBR, and (ii) what individual characteristics are associated with ability to identify climate-related actions. Recognizing that all Australians have the opportunity to contribute to protecting the GBR and that addressing climate threats is not constrained to communities living adjacent to the GBR, this study uses a representative national sample.

METHODS

Participant recruitment

We conducted a national online survey with a representative sample of Australian adults, recruited via a social research company (PureProfile). The survey was administered during February 2019 (Ethical approval #2018002524). The 2018–2019 summer was the warmest summer on record for Australia at that time. However, due to the cooling effect of tropical cyclones and regional weather conditions, there was no large-scale coral bleaching during this period (Great Barrier Reef Marine Park Authority, 2020). The invitation to participate did not mention the survey topic; the survey preamble did not...
mention climate change or the GBR, stating “You are invited to complete a survey about environmental issues...” The final sample comprised 4,285 participants (mean age 48.3 years; SE = 0.3, 49% male). One-third (35.7%) had received a university education and 56.5% reported visiting the GBR.

2.2 Top of mind awareness of GBR conservation actions

An open-ended question was posed to participants: “Say you were asked to do something to help the Great Barrier Reef. What types of actions do you think people like you could do that would be helpful for the Reef?” Participants were able to answer in an open-ended response box. This question was the first question presented within the larger survey.

Additional survey content assessed (see Supplementary Material 1):

- Sociodemographics (age, gender, education)
- State of residence (Queensland yes/no)
- Reef visitation (visited the GBR yes/no)
- Voting pattern (major conservative party, yes/no)
- Past behaviors—private sphere/climate (reducing energy use in the home, making an effort to drive or fly less frequently, 5-point scale)
- Past behaviors—public sphere/civic (writing letters to a politician, signing petitions about an environmental issue, 5-point scale)

Qualitative responses were initially reviewed to identify emergent groups of actions (e.g., responding to specific threats, domain of action). Differences between respondents mentioning climate change and climate-related actions and other respondents were examined using logistic regression (see Supplementary Material 1).

3 RESULTS

3.1 Top of mind awareness about reef protection actions

Only 1 in 25 participants (4.1%; 177/4,285) identified at least one specific action that related to climate change: 2.7% (n = 117) listed a private-sphere action, and 2.1% listed a public-sphere action (1.6% civic action, n = 68; 0.8% donating money to climate-related causes, n = 36) (Table 1, Figure 1). Another 3.8% mentioned the need to stop climate change but did not list a specific action related to this.

Almost one third of respondents listed donating money (17.1%, n = 731) or an alternative public sphere action (8.4%; n = 361) without specifically mentioning climate change in their response. The most common group of responses related to pollution (34.8%, n = 1,493), with most of these describing actions related to plastic pollution and litter (25.6%, n = 1,098). Most participants mentioning pollution (79.2%; 1,182/1,493) did not mention climate change. A small proportion (10.1%; n = 431) of respondents cited localized impacts on the GBR, such as reducing tourism (4.4%; n = 189), or shipping (2.7%; n = 114) impacts; many of these responses reflected the need to address a threat rather than an individual action (e.g., “Stop shipping activity”) (Table 1). While almost one third of respondents were not able to identify any action, only 4.2% (n = 182) indicated that they did not think individuals could do anything to help, and less than 1% (n = 24) responded negatively (Table 1).

3.2 How do individuals mentioning climate change differ from other respondents?

Logistic regression identified several differences between respondents who mentioned climate change or climate-related action, and those who did not. Individuals who mentioned climate change or climate-related actions were more likely to report higher educational attainment, previous visitation to the GBR, were less likely to vote for a major conservative party, and were more likely to report prior private-sphere carbon reduction and public-sphere actions (Figure 2, Supplementary Material 2).

4 DISCUSSION

The Reef Blueprint for Resilience emphasizes the importance of empowering people to reduce emissions for the benefit of the GBR (Great Barrier Reef Marine Park Authority, 2017). However, our findings demonstrate that most Australians do not connect health of the GBR with individual actions that tackle its greatest threat—climate change. Within private-sphere actions, responses targeting energy consumption were vastly outnumbered by plastic consumption behaviors. Within public-sphere actions, climate-related civic and donation behaviors (1.6% and 0.8%, respectively) were outnumbered by responses highlighting the need for policies to target localized threats (approaching 10%, e.g., “ban sunscreens,” “stop commercial fishing”) and generic civic and donation behaviors not linked to any threat (8.4% and 17.1%). The lack of target for these generic public-sphere actions suggests that
| Category                          | Examples of responses                                                                 | N   | %     |
|----------------------------------|----------------------------------------------------------------------------------------|------|-------|
| **Actions related to climate change** |                                                                                       |      |       |
| Generic climate appeal only (no specific action) | Stop global warming  
Respect climate change | 338 | 7.9%  |
| Private-sphere climate actions | Source my electricity supply from renewable retailers  
Carpool, reduce use of air conditioning, support the clean power plan….  
Don’t drive so much for less emissions, Reduce my carbon footprint | 161 | 3.8%  |
| Public-sphere climate actions (Civic) | Vote for governments who will go for less use of coal  
Lobby government to do more to limit climate change… bring back carbon tax  
Write to our pollies to activate change in their policies re climate change | 117 | 2.7%  |
| Public-sphere climate actions (Donations) | Donate to a charity- reduce emissions  
More money to help climate change | 68  | 1.6%  |
| **Public-sphere actions (no mention of climate change in any part of response)** |                                                                                       | 987 | 23%   |
| Public-sphere (Donations) | Donate  
Help with money | 731 | 17.1% |
| Public-sphere (Civic) | Write to politicians, Sign petitions  
Participate in activism | 361 | 8.4%  |
| **Actions related to pollution** |                                                                                       | 1493| 34.8% |
| Plastics & physical waste | Stop using single use plastics  
Recycle more, Limit use of plastic bags | 1098| 25.6% |
| Generic appeal to reduce pollution | Keep it clean  
Be conscious of pollution | 342 | 8.0%  |
| Agriculture and water quality | Support actions and legislation to limit waste runoff such as pesticides  
Encourage better control of agricultural run off | 83  | 1.9%  |
| Household actions and water quality | Not putting chemicals down the drain  
Use more environmentally friendly cleaners and detergents, | 50  | 1.2%  |
| **Actions related to localised impacts** |                                                                                       | 431 | 10.1% |
| Reduce visitor impacts | Limit tourist access  
Make it a “no go” area for a while | 189 | 4.4%  |
| Reduce use of sunscreen | Don’t use sunscreens when visiting  
Get sunscreen banned | 81  | 1.9%  |
| Reduce shipping impacts | Keep boats and anchoring away from sensitive areas  
Stop any mining or shipping activity within the reef | 114 | 2.7%  |
| Remove crown of thorns | Volunteer for things like killing crown of thorn starfish  
Dive and remove the star fish | 43  | 1.0%  |
| Reduce fishing | Stop commercial fishing, Less fishing | 41  | 1.0%  |
| **Nonspecific actions** |                                                                                       | 614 | 14.3% |
| Consumption behaviors | Reduce consumption  
Buy products that support protecting the reef | 113 | 2.6%  |
| Become more aware | Be more aware of our environmental footprint in general  
Keep up to date with environmental issues that impact marine and coral life | 102 | 2.4%  |
| Encourage others | Educate myself and others more  
Helping people be aware of the current situation of the reef | 304 | 7.1%  |
| Visit more | Promote its wonderful attractions  
Visit the area on holiday | 125 | 2.9%  |

(Continues)
TABLE 1 (Continued)

| Category                  | Examples of responses                                      | N   | %    |
|---------------------------|------------------------------------------------------------|-----|------|
| No action                 |                                                            | 1298| 30.3%|
| Nonspecific positive statement | Save it from destruction Protect corals                  | 214 | 5.0% |
| Don’t know                | I’d be happy help but I’m unsure of what needs to be done Cannot think of anything I personally could do | 525 | 12.3%|
| Nothing                   | Nothing. I think this is a government responsibility I don’t think the average person can help | 182 | 4.2% |
| Negative response         | We should not interfere with nature Enough is already being done! | 24 | 0.6% |
| No (clear) response       |                                                            | 351 | 8.2% |

FIGURE 2 Findings from logistic regression indicating differences between respondents who identified climate-related actions or mentioned climate change, and those who did not. Significant factors are in black; nonsignificant factors are in gray

these respondents may take action that does not address climate-related threats (e.g., signing petitions about plastic pollution).

The concept of “carbon capability” has been used to describe capacity to “make informed judgments and to take effective decisions regarding the use and management of carbon, through both individual behavior change and collective action” (Whitmarsh et al., 2011). Surveys of U.K. residents indicate that carbon capability is low—while many people adopt some decarbonizing behaviors in the home, few consider civic engagement to support low-carbon societal transitions (Whitmarsh et al., 2011). In Australia, although recent polls describe growing agreement with climate action and decarbonization (Ipsos, 2018; Merzian et al., 2019), people report low uptake of mitigation behaviors, especially in the public sphere (Supplementary Material 2) (Ipsos, 2020; Miranti & Evans, 2019).

This highlights a major opportunity for national campaigns about protecting the GBR to clearly communicate the importance of adopting specific private and public-sphere behaviors that contribute to emissions reduction. Any such initiative needs to be informed by behavioral science, which recognizes that issue awareness is not sufficient for change, and that behavior change campaigns must target specific drivers of (or barriers to) performing target behaviors (McKenzie-Mohr & Schultz, 2014; Nilsson et al., 2020; Reddy et al., 2017). Once key influences on behavior are identified—psychological, contextual, or capacity—these factors can then be targeted for intervention (Schultz, 2014). For example, interventions may target psychological behavioral drivers: communicating the positive actions of others can strengthen positive social norms and promote behavior change (Allo & Loureiro, 2014; Osbaldiston & Schott, 2012). Interventions may also address contextual barriers or personal capacity by making behaviors easier—these may include programs that change opt ins systems for green energy to opt out, provide skills-based training for reducing resource use in the home, or provide rewards for adopting new behaviors (Ashton-Graham & Newman, 2013; Ebeling & Lotz, 2015; Osbaldiston & Schott, 2012). Yet, despite the evidence to support both the need for climate action and the potential utility of behavioral science, a number of challenges remain.

The first challenge relates to the emphasis on plastic pollution and litter. The high frequency of pollution-related responses likely stems from ease of performance, extensive media coverage of issues related to single-use plastics and their impact on marine ecosystems (Stafford &
Jones, 2019), the high visibility of plastic pollution (Lotze, Guest, O’Leary, Tuda, & Wallace, 2018), and the tendency of people to anchor their conceptualization of environmental problems within familiar frames (Whitmash et al., 2011). It has been argued that this focus on plastic provides “a convenient truth” that creates a distraction from the more pressing need for major shifts in behavioral, political, and economic systems required to address climate change (Stafford & Jones, 2019). However, it may be possible to link this awareness of plastic pollution with the broader issues affecting the GBR through “positive behavioral spillover,” which theorizes how performing a particular behavior may increase uptake of other behaviors (Thøgersen & Ölander, 2003). This raises the question of whether engaging in plastic-related behaviors constrains or provides an entry point for participation in higher-impact actions. Emerging research indicates that reminding individuals of past behaviors can strengthen perceived capability and environmental identity, which may then increase uptake of new behaviors (Lauren, Smith, Louis, & Dean, 2019). Further research should examine communication approaches targeted to those adopting plastic-reduction behaviors; specifically, do messages emphasizing environmental identity and capacity for action in this group strengthen uptake of climate-related behaviors?

The second challenge concerns which climate actions should be prioritized to strengthen community efforts to protect the GBR. While there is agreement on the need to engage communities in climate-related actions (Great Barrier Reef Marine Park Authority, 2017), there is less clarity about which of the many climate-related actions (Figure 1) should be targeted for engagement and behavioral campaigns. There are several approaches to prioritizing private and public-sphere climate actions. It is important to consider the impact each behavior on emissions (Gardner & Stern, 2008; Wynes & Nicholas, 2017); however, impact varies with the social and technical context in which the action is performed. It is also important to consider selecting a target behavior which most of the population can perform; this can enhance the reach and impact of behavioral campaigns (Attari, DeKay, Davidson, & de Bruin, 2011; Dietz, Gardner, Gilligan, Stern, & Vandenbergh, 2009; Larson et al., 2015; Stern & Wolske, 2017). It is recognized that reducing emissions in the private-sphere will be insufficient to reach climate targets; this highlights the need for a strong focus on public-sphere actions. While it is difficult to quantify the relative impact of different public-sphere actions (Wynes & Nicholas, 2017), promoting public-sphere engagement is considered essential to enable policy and structural changes (Brien, 2015).

Most research examining the effectiveness of behavior change interventions has focused on changing private-sphere behaviors rather than public-sphere behaviors (Larson et al., 2015; Osbaldiston & Schott, 2012) and the promotion of public-sphere behaviors has usually been the focus of nongovernment organizations (NGOs). The subsequent resistance to policy change by governments can create a polarizing political culture, where individuals may adopt views on climate-related issues that align with their political identity (Hornsey, Harris, & Fielding, 2018). Consistent with such research, our respondents mentioning climate change or climate actions were less likely to support major conservative political parties. Research suggests that climate communication with conservatives can be enhanced by using trusted “in group” messengers, communicating agreement between scientists, or framing communication to align with audience values such as technological advancement (Bain, Hornsey, Bongiorno, & Jeffries, 2012; Hornsey & Fielding, 2019; van der Linden, Leiserowitz, & Maibach, 2018). Nonetheless, this polarization around climate action, combined with the low “top of mind awareness” of climate-related behaviors found in this study, demonstrates the challenge faced by organizations seeking to foster community involvement in public-sphere climate actions to protect the GBR.

Our question focused on individual actions (“what could someone like you could do…”). Consistent with other research indicating that private-sphere actions are the most commonly adopted behaviors (Larson et al., 2015; Whitmarsh et al., 2011), most responses focused on private-sphere actions. Responses to survey questions can be influenced by question wording (Krosnick, 2018; Kyselá, Ščasný, & Zvěřinová, 2019). Given this, it would be interesting for future research to explore how different framing of open-ended questions (e.g., “What would you like to see governments do?”) might influence recognition of the need for climate-related actions. Nonetheless, the low frequency of climate-related responses was observed for both private and public-sphere behaviors. It is likely that participants not mentioning climate change were heterogeneous, potentially comprising those who are (i) unaware that climate change is a major reef threat, (ii) aware that climate change is a threat, but unaware of mitigation actions, and (iii) aware of climate threats and mitigation actions but perceive actions to have limited effect. Fewer than 5% of respondents indicated that individuals could do nothing, suggesting that most respondents are either unaware of climate threats or climate actions. Our research focused on Australians and an iconic Australian ecosystem. It is unclear whether our findings translate to other social settings or conservation issues. There are many reasons to promote climate action; it would be interesting for further research to assess whether iconic ecosystems such as the GBR strengthen support for climate action.
4.1 Conclusion

There is increasing recognition that effective conservation involves understanding and changing human behavior. Our findings suggest that conservation challenges, even high-profile ones, require structured engagement approaches to support appropriate social change. Conservation of the GBR requires urgent action to limit the impact of anthropogenic climate change. However, our findings show that most Australians do not associate the health of the GBR with individual climate-related actions. Initiatives that seek to engage community members in reef conservation need to move beyond generic calls to action (such as “protect the reef”); rather, communication and engagement initiatives should promote uptake of specific climate-related actions while also addressing drivers of action (such as social norms or perceived capacity). Ideally, we must encourage Australians to not just reduce emissions in the home, but to also communicate their support for decarbonization with political representatives and the broader community.

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AUTHOR CONTRIBUTIONS
Study concept and design: Angela J Dean and Kerrie A Wilson. Quantitative analysis: Angela J Dean. Analysis and interpretation of qualitative data: Angela J Dean and Robyn E Gulliver. Drafting of the manuscript: Angela J Dean. Critical revision of the manuscript for important intellectual content: Robyn E Gulliver and Kerrie A Wilson.

ETHICS STATEMENT
This research was approved by The University of Queensland Human Research Ethics Committee.

DATA ACCESSIBILITY STATEMENT
All data that is permissible to share according to ethical requirements is available upon request to the authors.

CONFLICT OF INTEREST
The authors have no conflict of interest.

ORCID
Angela J. Dean PhD © https://orcid.org/0000-0003-4017-4809

Robyn E. Gulliver PhD © https://orcid.org/0000-0002-8827-7850
Kerrie A. Wilson PhD © https://orcid.org/0000-0002-0929-935X

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Additional supporting information may be found online in the Supporting Information section at the end of the article.

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