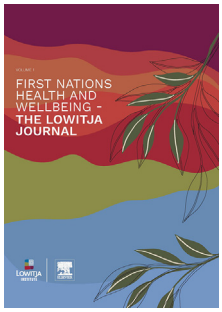

Original Research

A network cross-cultural validation of the Parenting Sense of Competence Scale between Aboriginal and Torres Strait Islander and non-Aboriginal and Torres Strait Islander Australians

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Abstract

Purpose The Parenting Sense of Competence Scale (PSOC) is the most used instrument worldwide to measure parenting sense of competence. Considering that cultural differences influence parenting practices, an investigation of cross-cultural validity was required to ensure that PSOC scores can be compared between Aboriginal and Torres Strait Islander and non-Aboriginal and Torres Strait Islander Australians. To address this research gap, this study employed network psychometrics to investigate the cross-cultural validity of the PSOC between Aboriginal and Torres Strait Islander and non-Aboriginal and Torres Strait Islander Australians.

Methods The study investigated the network psychometric properties of the PSOC instrument, specifically: (1) model estimation; (2) item redundancy; (3) dimensionality; (4) measurement invariance; (5) model fit; (6) criterion validity; and (7) reliability. The network model that was used was the Gaussian graphical model estimated with the graphical least absolute shrinkage and selection operator. Dimensionality was evaluated with exploratory graph analysis. Measurement invariance was evaluated via permutation testing. Data were from the South Australian Aboriginal Birth Cohort (n=178) and eMums study (n=107).

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Main findings The findings indicated that, after accounting for item redundancy, a revised 14-item version of the PSOC displayed the two theoretical dimensions of Efficacy and Satisfaction and was cross-culturally valid among Aboriginal and non-Aboriginal Australians.

Principal conclusions The revised 14-item PSOC displayed excellent psychometric properties and is readily available to be used in Australia.

Keywords: Aboriginal and Torres Strait Islander Australians; Cross-cultural validity; Exploratory Graph Analysis; Measurement invariance; Parenting Sense of Competence Scale

Highlights

- The Parenting Sense of Competence Scale (PSOC) displayed good psychometric properties among Aboriginal mothers.
- The PSOC displayed cross-cultural invariance between Aboriginal and non-Aboriginal mothers.
- Two dimensions of parenting sense of competence, Efficacy and Satisfaction, were identified.
- Future research should develop culturally-specific instruments for Aboriginal peoples.

Introduction

In a seminal research paper, Bandura (1977) proposed that an individual's sense of personal competence (also referred to as 'self-efficacy'), defined as an individual's perceived ability to overcome obstacles and achieve desired outcomes, is fundamental to motivating effort and promoting persistence (Latham et al. 2018). Since then, several instruments have been developed to measure sense of personal competence. One widely used instrument is the General Self-Efficacy (GSE) scale, which had its psychometric properties replicated in 25 countries with diverse socioeconomic and cultural contexts, such as lower-income (e.g. Syria), lower-middle-income (e.g. India), upper-middle-income (e.g. Indonesia, Korea) and high-income (e.g. Canada, USA) countries, providing robust evidence that sense of personal competence is a cross-culturally meaningful construct (Scholz et al. 2002). However, while the GSE scale has been applied in empirical research to measure self-efficacy in Indigenous populations in Australia (Priest et al. 2012), Canada (Barnabe et al. 2023) and New Zealand (Wyeth et al. 2013), among other countries (Teoh et al. 2024), it is believed that there are no studies that have specifically validated the GSE for an Indigenous population.

The construct of sense of personal competence is also important in the context of parenting practices. When parents feel personally competent in their parenting abilities, they are more likely to engage in positive parenting practices such as providing warm and responsive care-giving, providing stimulation and fostering child development (Rogers and Matthews 2004). Conversely, carers who do not experience parenting sense of competence feel exceedingly burdened by the responsibility, lack persistence and do not perceive the parental experience as enjoyable (i.e. no satisfaction). In these cases, lack of parenting sense of competence can lead to psychological unavailability and in more extreme cases is a precursor to child maltreatment (Coleman and Karraker 1998).

Research evidence from systematic reviews and meta-analyses has indicated that low parenting sense of competence is associated with poorer outcomes for both carers and children. For example, low parenting sense of competence is associated with higher depression among carers (Goodman et al. 2022), while low parenting sense of competence (of their carers) is associated with conduct issues among children (Albanese et al. 2019).

Parenting sense of competence has been conceptualised as having two overlapping dimensions: efficacy (the degree to which parents feel competent, capable of problem-solving and familiar with parenting) and (lack of) satisfaction (the degree to which parents feel frustrated, anxious or poorly motivated in their parenting role). Overlap in these dimensions occurs, since it is difficult to obtain satisfaction in an activity that one has no efficacy and it is also difficult to obtain efficacy in an activity in which one has no satisfaction (Coleman and Karraker 1998).

Measurement of parenting sense of competence

To measure parenting sense of competence, the most widely used psychological instrument is the 16-item Parenting Sense of Competence Scale (PSOC), developed by Johnston and Mash in 1989. Following the original validation, the psychometric properties of the PSOC have been examined in multiple countries, with the two theoretical dimensions (Satisfaction and Efficacy) being consistently demonstrated in countries such as Canada (Ohan et al. 2000), Spain (Oltra-Benavent et al. 2020) and China (Ngai et al. 2007), among others (Jankowska et al. 2022). While the PSOC has been applied in empirical research to measure parenting sense of competence in Indigenous populations in Australia (Pasalich et al. 2021), Canada (Lindenbach et al. 2024) and the United States (Mullany et al. 2012), among others (Chu et al. 2018), it is believed that there are also no studies that have validated the PSOC for any Indigenous populations worldwide, including Aboriginal and Torres Strait Islander populations.

In Australia, the PSOC psychometric properties were evaluated by Rogers and Matthews (2004) in a sample of 849 mothers and 329 fathers from Victoria. In addition to the original two-dimensional structure (Efficacy and Satisfaction), Rogers and Matthews (2004) also identified an Interest dimension, comprising the items: 'My talents and interests are in other areas, not in being a parent' and 'If being a father of a child were only more interesting, I would be motivated to do a better job as a parent'. In a subsequent study conducted in Australia, Gilmore and Cuskelly (2009) evaluated the PSOC psychometric properties among a sample of 586 mothers and 615 fathers from the general Australian population. The authors again identified a three-dimensional structure; the Efficacy and Satisfaction dimensions and the third dimension Interest comprised the same two items Talents and Interest (see Supplementary Table S1 for all item labels). Despite these previous validations in Australia, the validity of the PSOC has not been investigated for Aboriginal and Torres Strait Islander peoples and, more broadly, there is no instrument measuring parenting sense of competence that has been developed or validated for Aboriginal and Torres Strait Islander peoples (to the best of the authors' knowledge).

The validation of culturally-appropriate instruments for Aboriginal and Torres Strait Islander peoples

There are multiple reasons why developing culturally-specific measures for Aboriginal and Torres Strait Islander peoples is required. Aboriginal and Torres Strait Islander peoples comprise highly heterogeneous groups, with more than 500 different clans at the time

of English settlement (Griffiths et al. 2019), and these unique cultures impact parenting practices and parental sense of competence (Crijnen et al. 1997). For example, when investigating traditional practices and values of Aboriginal peoples living in Central and Western Desert regions of Australia, Aboriginal languages reveal ancient and deeply nurturing child-rearing practices expressed in the Luritja and Pitjantjatjara word *kanyini*, the Warlpiri word *mardani*, the Pintupi word *kanyininpa* and the Kukatja word *kanyirninpa*. These words have similar meaning in each language, representing 'holding, looking after, nurturance' and these practices (respectfully referred to here as *kanyininpa)* have been employed to nurture young Aboriginal people into adulthood for thousands of years (Ryan 2011, p. 189). Although *kanyininpa* resembles to some extent the Western concept of attachment, the concept of *kanyininpa* is broader since it also includes attachment to kin, community and Country. Traditional rearing practices such as *kanyininpa* are used to raise children in certain Aboriginal cultures in contemporary Australia and constitute a culturally appropriate alternative to Western models of child rearing (Ryan 2011).

In cross-cultural psychology, these cultural differences can be understood according to three ontological perspectives: absolutism; relativism and universalism (Berry 2002). The authors of this study reject the perspectives of absolutism, which considers that psychological processes are universal and unaffected by cultural differences, and relativism, which considers that psychological processes exist only within a certain culture and there are no communalities across cultures. The authors instead adopt the perspective of universalism, which believes that certain psychological processes are 'common' to the human experience (e.g. sadness) but their expression can be notably different across cultures (Hedges et al. 2023). In practice, this means that while certain Western-developed instruments are not valid for Aboriginal and Torres Strait Islander Australians (e.g. the Strengths and Difficulties Questionnaire, SDQ) (Ribeiro Santiago et al. 2021), other Western-developed instruments can capture (at least partially) the expression of a psychological process that is also meaningful for Aboriginal and Torres Strait Islander peoples (Brown et al. 2012). In the case that the expression of a psychological process is shared across cultures, cross-cultural comparison then becomes a possibility (Bastos et al. 2021). Based on evidence from the past decade (Le Grande et al. 2017), the adaptation and validation of Western-developed instruments by Aboriginal and Torres Strait Islander peoples (e.g. EQ-5D-5L to measure quality of life) can be useful to (at least partially) capture a meaningful psychological process (and answer associated research questions) (Ribeiro Santiago et al. 2021). The adaption of a Western-developed instrument can then be employed until a more extensive research process develops an instrument that is tailored for Aboriginal and Torres Strait Islander peoples and covers broader domains (e.g. Good Spirit, Good Life tool to measure quality of life) (Smith et al. 2021), replacing the previous adaptation of a Western-developed instrument.

The development and adaptation of instruments for Aboriginal and Torres Strait Islander peoples should be conducted from a decolonial perspective (Hedges et al. 2023). Historically, psychological assessment has been used to reinforce colonial norms (Cushman 2016) and in multiple circumstances to marginalise Aboriginal and Torres Strait Islander peoples (Ranzijn and Nolan 2009). From a decolonial perspective, psychological assessment is never used to maintain and conform to a colonial system of knowledge but instead to privilege Aboriginal and Torres Strait Islander peoples' knowledge, voices and self-

determination, taking into consideration social, historical and political contexts (Hedges et al. 2023). More specifically, the measurement of parenting sense of competence among Aboriginal and Torres Strait Islander peoples' needs to consider the intergenerational and nefarious impacts of colonisation and assimilation policies, which have resulted in the forceful removal of Aboriginal and Torres Strait Islander children from their parents (these children are called the 'Stolen Generations') (Dudgeon et al. 2014). A decolonial perspective is also a strength-based approach acknowledging that, despite the nefarious intergenerational effects of colonisation, Aboriginal and Torres Strait Islander peoples and their knowledges have immense strength and have thrived in contemporary Australia (Bullen et al. 2023).

The current study

During the conceptualisation of this project, Aboriginal researcher Ms Hedges, non-Aboriginal and Torres Strait Islander collaborators and the Aboriginal and Torres Strait Islander Reference Group identified the PSOC as a potentially meaningful measure of parenting sense of competence for Aboriginal and Torres Strait Islander peoples, recommending the need for further psychometric evaluation. The need to evaluate whether the elements of parenting sense of competence measured by the PSOC were meaningful for *both* Aboriginal and Torres Strait Islander and non-Aboriginal and Torres Strait Islander Australians was also identified (that is, whether the PSOC was cross-culturally valid for these populations). One beneficial feature of the PSOC is that it can be applied in multiple contexts, such as research (Snyder et al. 2023), clinics and hospitals (Bui et al. 2017; Huang et al. 2023) and schools (Buchanan-Pascall et al. 2023), among others (e.g. to homeless individuals) (Rybski and Israel 2017). Overall, establishing a culturally-valid measure was considered important for answering research questions related to parenting sense of competence among Aboriginal and Torres Strait Islander peoples. For example, whether parenting sense of competence mediates the effect of Aboriginal and Torres Strait Islander mothers' experience of racism on their children's social and emotional wellbeing (Snyder et al. 2023).

To address these research gaps the current study aimed to evaluate the cross-cultural validity of the PSOC between Aboriginal and Torres Strait Islander and non-Aboriginal and Torres Strait Islander Australians. The cross-cultural validation of the PSOC was conducted within the framework of network psychometrics (Borsboom et al. 2021). Since its introduction a decade ago, network psychometrics centres on the substantive claim that psychological processes (e.g. personality, psychopathologies, attitudes) are not commonly caused by an unobservable ('latent') trait but instead emerge from the causal interaction among its constituting behaviours (Bringmann et al., 2021). Considering that the observed covariance between item responses in a questionnaire (measuring these behaviours) can be explained by these causal interactions (Van Der Maas et al. 2006), the validity of psychological questionnaires (e.g. dimensionality, model fit) can be examined entirely within the network perspective (Christensen et al. 2023). For example, the number of clusters identified in the network through community detection algorithms indicates the dimensionality of the psychological instrument (and subscale scores can be calculated for each of these dimensions) (Golino et al. 2020). Please refer to Christensen et al. (2020) for an in-depth explanation of the psychometric validation of questionnaires using network models. Network psychometrics has been recommended in Aboriginal and Torres Strait Islander research due to representing psychological processes

(e.g. social and emotional wellbeing) as complex systems of behaviours (i.e. nodes) and their associations (i.e. edges), capturing the holistic nature of Aboriginal and Torres Strait Islander peoples' experiences and emulating their distinctive dot painting (Soares et al. 2021).

Furthermore, to conduct the cross-cultural validation (by directly comparing the use of the PSOC) between Aboriginal and Torres Strait Islanders and non-Aboriginal and Torres Strait Islanders, data were used from two distinct studies: the South Australian Aboriginal Birth Cohort (SAABC) and the eMums Plus study (henceforth referred to as eMums). The SAABC (Jamieson et al. 2021) was a prospective longitudinal birth cohort intended to evaluate factors influencing health, social, behavioural, cognitive, educational, dietary and anthropometric characteristics of Aboriginal and Torres Strait Islanders children over time. The eMums study (Sawyer et al. 2019) was a pragmatic randomised controlled trial of a four-month mobile phone app intervention that aimed to reduce levels of maternal postnatal depressive symptoms and improve the quality of maternal caregiving. These studies were chosen because they were among the few data sources in Australia that included PSOC responses (self-report, administered by field workers) from Aboriginal and Torres Strait Islander and non-Aboriginal and Torres Strait Islander mothers, respectively. This study was a secondary analysis of the SAABC and eMums studies (the validation was not a primary objective of these studies) and ethical approval was received for this analysis (more details in the Methods section).

Another important feature of the SAAB and the eMums is that both studies included complementary measures that enabled a comprehensive investigation of the PSOC criterion validity. Criterion validity refers to the degree to which test scores are associated with external variables that the test scores are expected to be associated with according to psychological theory (Rosenbaum 1989). For example, according to psychological theory, it is expected that a higher parenting sense of competence would be associated with higher parental and family adjustment (Jones and Prinz 2005), higher quality of mother-child interaction (Abarashi et al. 2014), lower parenting stress (Crnic and Ross, 2025), lower postnatal depression (Gross and Marcussen 2017) and lower children's difficulties (Albanese et al. 2019). As such, this study evaluated whether higher parenting sense of competence (measured with the PSOC) was positively associated with higher parental and family adjustment (measured with the Parenting and Family Adjustment Scales in the SAABC), higher quality of mother-child interaction (measured with the Nursing Child Assessment Teaching Scale in the eMums study), lower parenting stress (measured with the Parenting Stress Index Fourth Edition in the eMums study), lower postnatal depression (measured with the Edinburgh Postnatal Depression Scale in the eMums study), and lower children's difficulties (measured with the SDQ in the SAABC).

In summary, this study conducted a comprehensive evaluation of the PSOC psychometric properties among Aboriginal and Torres Strait Islander and non-Aboriginal and Torres Strait Islander Australians, including evaluation of: (1) model estimation; (2) item redundancy; (3) dimensionality; (4) measurement invariance; (5) model fit; (6) criterion validity; and (7) reliability.

Methods

Positionality statement

The research team involved in this work comprised Aboriginal (Ms Joanne Hedges) and non-Aboriginal and

Torres Strait Islander researchers (Dr Pedro Henrique Ribeiro Santiago, Dr Alyssa Sawyer, Dr Michael Sawyer and Prof. Lisa Jamieson). Considering the history of misuse of psychological assessment among Aboriginal and Torres Strait Islander peoples (Ribeiro Santiago 2020), the research team is committed to promoting culturally sensitive psychological assessment among Aboriginal and Torres Strait Islander peoples. The research team is also committed to embracing Aboriginal and Torres Strait Islander epistemologies and ways of knowing, the principle of Aboriginal and Torres Strait Islander data sovereignty and the importance of best research evidence to promote social equity for Aboriginal and Torres Strait Islander peoples in Australia. In this study, Ms. Joanne Hedges, who is the Aboriginal Senior Research Officer and Director of the Indigenous Oral Health Unit at the University of Adelaide, provided cultural mentorship throughout the entire research process, including guidance to the analysis, interpretation and writing of findings.

Participants

South Australian Aboriginal Birth Cohort (SAABC)

Eligibility involved being a pregnant mother with an Aboriginal and Torres Strait Islander child residing in South Australia (SA) during the recruitment period between February 2011 and May 2012. Recruitment occurred through the antenatal clinics of SA Aboriginal community-controlled health organisations and hospitals. At baseline, 448 mothers who were pregnant with an Aboriginal and Torres Strait Islander child were recruited, representing two-thirds of the eligible population, and the sample was representative according to age, socioeconomic position and tobacco smoking status. The SAABC follow-ups occurred when the children were 2, 3, 5 and 7 years old (Jamieson et al. 2021).

Following recommended procedures in cross-cultural assessment (Geisinger 1994), all psychological instruments included in the SAABC were evaluated by a 15-member Aboriginal and Torres Strait Islander reference group. The Aboriginal and Torres Strait Islander reference group determined which psychological instruments were relevant for Aboriginal and Torres Strait Islander Australians and could be included in the SAABC, recommending further psychometric validation to ensure their construct validity for Aboriginal and Torres Strait Islander peoples. For in-depth information about the SAABC, please refer to Jamieson et al. (2021).

For the purposes of this study, data from the SAABC 5-year follow-up were used. At the 5-year follow-up, the response sample included 288 mothers of Aboriginal and Torres Strait Islander children (among them, 221 mothers were Aboriginal and Torres Strait Islander peoples). Considering that 448 mothers who were pregnant with Aboriginal and Torres Strait Islander children participated at the baseline, the retention rate at the 5-year follow-up was 64.3% (Jamieson et al. 2019). For this study, the response sample at the 5-year follow-up included 221 Aboriginal and Torres Strait Islander mothers. Among the response sample (n=221), 98 Aboriginal and Torres Strait Islander mothers identified with a tribal group, a language group or clan (44.3%), such as Kaurna, Ngarrindjeri, Adnyamathanha and Barngarla, among others. Furthermore, among the response sample (n=221), 121 Aboriginal and Torres Strait Islander mothers lived in a metropolitan area (54.8%), 51 Aboriginal and Torres Strait Islander mothers lived in a regional area (23.1%) and 49 Aboriginal and Torres Strait Islander mothers lived in a remote area (22.1%). In comparison with the estimated resident Aboriginal and Torres Strait Islander population in SA (ABS 2021), a similar proportion of Aboriginal and Torres Strait Islander mothers (in the response sample) lived in a

metropolitan area (54.8% compared with 53.8%), a higher proportion lived in a remote area (22.1% compared with 13.4%) and a smaller proportion lived in a regional area (23.1% compared with 32.8%). Missing data on the PSOC individual items ranged from 2.2 to 12.1 per cent. Considering that the performance of imputation methods still needs to be evaluated for network models, the analysis was conducted in the complete case sample (n=178), including only Aboriginal and Torres Strait Islander mothers who had complete responses to all PSOC items.

The eMums study

Eligible participants were mothers of infants aged 2 to 8 weeks at the time that they completed their 1- to 4-week postnatal health check at South Australian community clinics. The eligibility for the trial further required: (1) a score of ≥7 on the Edinburgh Postnatal Depression Scale (EPDS); (2) at least one self-reported parenting problem; (3) literacy in English; and (4) access to a smartphone. Recruitment occurred when mothers were contacted for their postnatal health check offered to all mothers in SA. The study follow-ups occurred when children were aged 1 to 2 (pre-intervention), 8 and 12 months. For in-depth information about the eMums study, please refer to Sawyer et al. (2019).

For this study, 12-month follow-up data from the eMums study were used. At the 12-month follow-up, the response sample included 108 non-Aboriginal and Torres Strait Islander Australian mothers and two Aboriginal and Torres Strait Islander Australian mothers. Considering that 125 non-Aboriginal and Torres Strait Islander Australian mothers and three Aboriginal and Torres Strait Islander Australian mothers participated at baseline, the retention rate at the 12-month follow-up was 85.9 per cent (Sawyer et al. 2019). For this study, the response sample at the 12-month follow-up included 108 non-Aboriginal and Torres Strait Islander mothers. Missing data on the PSOC individual items ranged from 0.00 to 0.93 per cent. The analysis included eMums data from non-Aboriginal and Torres Strait Islander Australian mothers who had complete responses to all PSOC items (n=107).

Measures

Sociodemographic characteristics

Sociodemographic characteristics evaluated at the studies' baseline assessment were maternal age, educational attainment and source of household income. To enable comparability across both studies, variables were dichotomised regarding educational attainment (high school or less/trade or university) and source of household income (employment/other). For descriptive purposes, maternal age (<29 years/≥29 years) was also dichotomised according to the median maternal age (29 years) across both studies.

Parenting Sense of Competence Scale

The PSOC (Johnston and Mash 1989) is a 16-item instrument that measures parents' sense of confidence and satisfaction with their parenting. The items are rated on a 6-point scale (1 = Strongly disagree, 2 = Somewhat disagree, 3 = Disagree, 4 = Agree, 5 = Somewhat agree and 6 = Strongly agree). Higher scores indicate a higher parenting sense of competence. The original validation conducted by Johnston and Mash (1989) empirically identified the two theoretical dimensions of Satisfaction and Efficacy. The PSOC was applied in the SAABC and eMums studies. The labels for all PSOC items are displayed in the Supplementary Table 1 (e.g. the item 'Sometimes I feel like I'm not getting anything done' is referred to by the label 'done').

Parenting and Family Adjustment Scales

The Parenting and Family Adjustment Scales (PAFAS) (Sanders et al. 2014) is a 30-item instrument that

measures changes in parenting practices and parental adjustment. The items are rated on a 4-point scale (1 = Not at all, 2 = A little, 3 = Quite a lot, 4 = Very much). Higher scores indicate lower parental and family adjustment. The PAFAS has two subscales: the 18-item Parenting subscale, which measures parenting practices and parent-child relationship, and the 12-item Family Adjustment subscale, which measures parental and familial adjustment (Sanders et al. 2014). The PAFAS was included in the SAABC study.

Nursing Child Assessment Teaching Scale

The Nursing Child Assessment Teaching Scale (NCAST) was designed to evaluate the quality of mother-child interactions, such as social-emotional growth fostering and cognitive growth fostering, exhibiting satisfactory psychometric properties (Sumner 1994). The instrument uses 3- to 5-minute video recordings of mothers teaching their children an appropriate skill for their age. Research assistants, who undertook the NCAST training program, coded the video recordings to generate a total score and subscale scores (Sumner 1994). Higher scores indicate higher levels of positive mother-child interaction quality. The current study used the Caregiver Total Score (ranging from 0 to 50). The NCAST was included in the eMums study.

Parenting Stress Index Fourth Edition

The Parenting Stress Index (PSI) is a 101-item self-report instrument that aims to assess parent and child characteristics that impact 'parent and child systems', in particular areas of stress that may affect healthy child development or the quality of parenting. The items are rated on a 5-point scale: 1 = Strongly agree, 2 = Agree, 3 = Not sure, 4 = Disagree, and 5 = Strongly disagree. The PSI has 15 subscales, and higher scores indicate higher parenting stress (Abidin 2012). The Competence (11 items) and Attachment (7 items) subscales were included in the eMums study. Despite originally comprising 13 items, two items from the Competence subscale measuring educational attainment were removed from the eMums study since they were considered not to have appropriate face validity as measures of parental competence. The PSI was included in the eMums study.

Edinburgh Postnatal Depression Scale

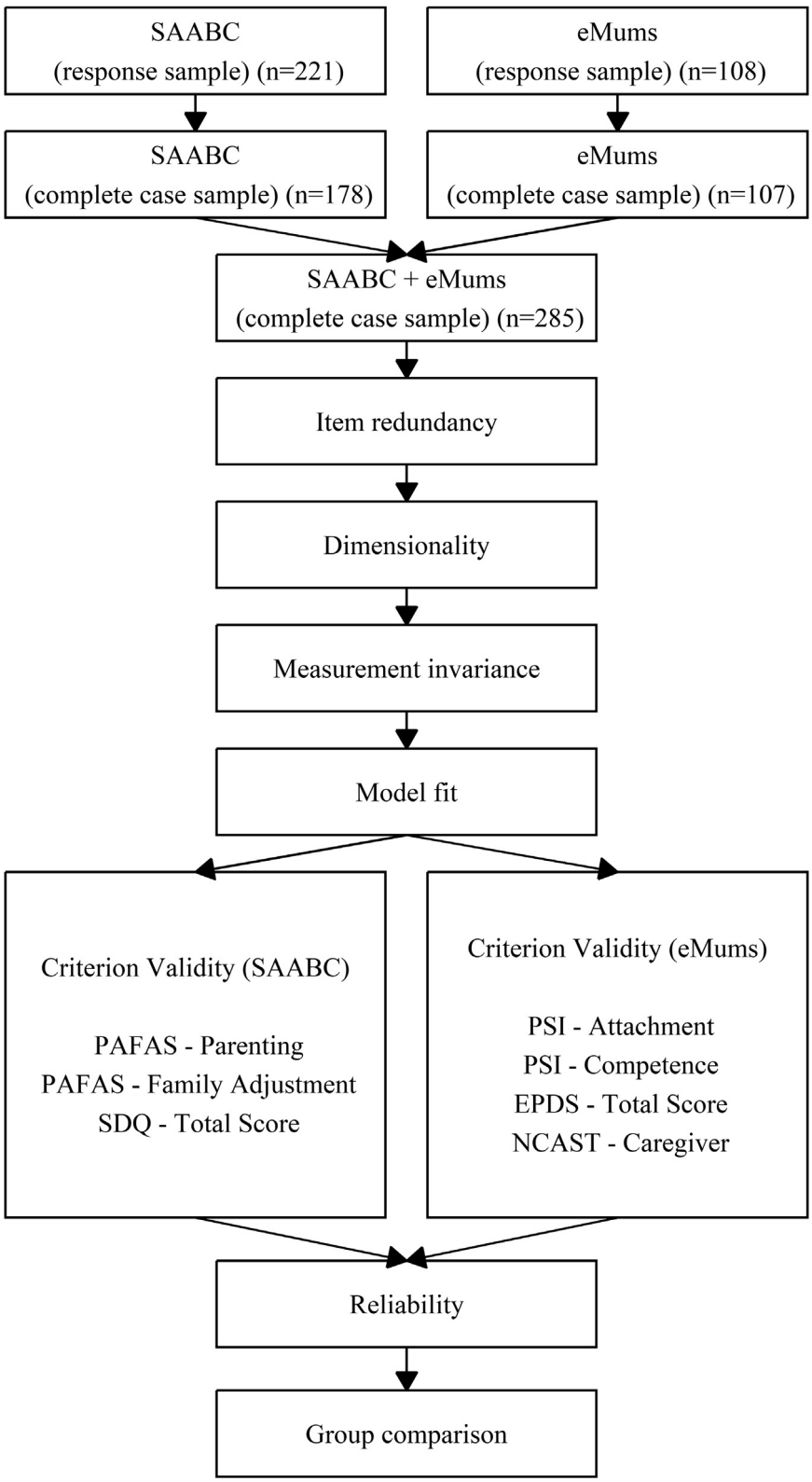
The EPDS (Cox et al. 1987) is a 10-item instrument that measures postnatal depression. The items are rated on a 4-point scale and items have different response categories. Higher scores indicate higher postnatal depression. The EPDS was developed as a unidimensional measure of postnatal depression (Cox et al. 1987). The EPDS was included in the eMums study.

Strength and Difficulties Questionnaire

The SDQ (Goodman 1997) is a 25-item instrument that measures the behaviours, emotions and relationships of children. The items are rated on a 3-point scale: 1 = Not true, 2 = Somewhat true, 3 = Certainly true. Higher scores indicate higher difficulties. The SDQ has five subscales; however, this study followed recent recommendations that SDQ subscale scores should not be calculated for Aboriginal and Torres Strait Islander children (Ribeiro Santiago et al. 2021). The SDQ was included in the SAABC study.

Statistical analysis

All statistical analyses were conducted with R software and R packages EGAnet (Golino and Christensen 2019) and psychonetrics (Epskamp 2023). To promote transparency and reproducibility of findings, the R script for the analysis can be found in the Open Science Framework (https://osf.io/2c9pw/). The flow diagram in Figure 1 outlines the stages of the cross-cultural validation of the PSOC, including processing the datasets (e.g. establishing the complete case samples) and the statistical analyses.


SAABC
(response sample) (n=221)
eMums
(response sample) (n=108)
SAABC
(complete case sample) (n=178)
eMums
(complete case sample) (n=107)
SAABC + eMums
(complete case sample) (n=285)
Item redundancy
Dimensionality
Measurement invariance
Model fit
Criterion Validity (SAABC)
PAFAS - Parenting
PAFAS - Family Adjustment
SDQ - Total Score
Criterion Validity (eMums)
PSI - Attachment
PSI - Competence
EPDS - Total Score
NCAST - Caregiver
Reliability
Group comparison

Network estimation

The first step of the analysis was the model estimation of the network model, which indicates how the items are (conditionally) associated and is used to inform the validity of the questionnaire in the subsequent analyses (e.g. the number of clusters identified in the network indicates the instrument dimensionality). In this study, the network model used was the Gaussian graphical model (GGM). In the GGM, nodes represent items and edges represent partial correlations controlling for all the other items in the network (i.e. conditional associations). The GGM was estimated with the graphical least absolute shrinkage and selection operator based on the minimisation of the extended Bayesian information criterion (Epskamp and Fried 2018). All networks were plotted with the Fruchterman-Reingold algorithm, which positions nodes according to the strength of their conditional association.

Item redundancy, dimensionality and measurement invariance

In the second step of the analysis, the network model was used to evaluate item redundancy. In a psychological network, the nodes (items) should refer to unique causal components (unique behaviours/symptoms) and should not be redundant (Bringmann et al., 2021). One problem with redundant items is that they display strong conditional associations (due to latent confounding), leading community-detection algorithms to identify redundant nodes as a separate cluster (a separate 'dimension'). However, this identified dimension comprising redundant items is spurious and has no theoretical and psychological meaning. To evaluate item redundancy, this study calculated the weighted topological overlap (wTO) statistic. The wTO indicates the extent to which two items establish similar (conditional) associations with the other items in the network and, consequently, are potentially redundant (the rationale is that if two items are redundant and measure the same behaviour, they are also expected to establish the same conditional associations with the other items) (Christensen et al. 2023). The wTO values range from 0 (indicating no overlap between items) to 1 (indicating complete overlap between items). In the context of psychological networks, values $\geq$0.25 indicate (potential) redundancy (Christensen et al. 2023). Where the wTO indicates item redundancy, the redundant items have their content evaluated and are only combined into a composite item (by summing the item scores) when there is conceptual overlap between the items (Ribeiro Santiago et al. 2021).

Once it was established that the network was made up of unique components and there was no item redundancy, the third step of the analysis was to evaluate dimensionality (i.e. the number of item clusters). In a psychological network, certain behaviours are more strongly conditionally associated than others (e.g. behaviours related to parenting satisfaction are more strongly conditionally associated than behaviours related to parenting efficacy), clustering together. Community detection algorithms can then be used to identify these clusters and establish the dimensionality of the instrument (i.e. which items are more strongly conditionally

Figure 1: Flow diagram of the cross-cultural validation of the Parenting Sense of Competence Scale (PSOC). The flowchart outlines the stages of the cross-cultural validation of the PSOC, including processing the datasets and statistical analyses. In the analysis of measurement invariance, in case measurement invariance was not established, all subsequent analyses (e.g. item redundancy) would have been conducted for the SAABC and eMums studies independently. SAABC, South Australian Aboriginal Birth Cohort; PAFAS, Parenting and Family Adjustment Scales; SDQ, Strengths and Difficulties Questionnaire; PSI, Parenting Stress Index Fourth Edition; EPDS, Edinburgh Postnatal Depression Scale; NCAST, Nursing Child Assessment Teaching Scale.

associated, constituting a psychological 'dimension' that can be represented by a subscale score). The application of community detection algorithms to identify dimensions in a psychological network is referred to as exploratory graph analysis (EGA) (Christensen et al. 2020).

To identify these item clusters, the Walktrap community-detection algorithm was employed (Golino et al. 2020). To examine structural consistency, whether an item cluster can be consistently identified in the presence of multiple item clusters in the network, the Walktrap algorithm was applied to 1,000 parametric bootstrap samples (Christensen and Golino 2021). The structural consistency of an item cluster was considered adequate when the cluster was identified in ≥75 per cent bootstrap samples (Golino et al. 2021). Where an item cluster displayed low structural consistency, the stability of the individual items belonging to that cluster (item stability) was evaluated. Item stability was considered adequate when the item belonged to the same item cluster in ≥75 per cent bootstrap samples (Golino et al. 2021). Once the item clusters (dimensions) were identified, network loadings were evaluated. Network loadings indicate the contribution of each item to the emergence of a coherent dimension (i.e. cluster) in the network (Christensen et al. 2023). Network loadings can be considered small (0.00 to 0.15), moderate (0.16 to 0.25), or large (0.26 to 0.35) (Christensen and Golino 2021).

Due to cultural differences, it was also necessary to evaluate configural invariance (i.e. whether node placement per cluster was equivalent across groups) and metric invariance (i.e. whether the network loadings were equivalent across groups). That is: it was necessary to establish (through configural and metric invariance) whether the measurement of parenting sense of competence was equivalent for Aboriginal and Torres Strait Islanders and non-Aboriginal and Torres Strait Islanders. To evaluate configural invariance, the Walktrap algorithm was applied to 1,000 parametric bootstrap samples and it was evaluated whether the items were identified in the same item cluster in ≥75 per cent bootstrap samples. To evaluate metric invariance, permutation testing was employed to compare the observed network differences across groups with a bootstrapped 'null distribution'. Uncorrected *P*-values and corrected *P*-values were examined with the Benjamini-Hochberg multiple comparison procedure (Jamison et al. 2024). The recommendations from Jamison et al. (2024, p. 173) that 'noninvariant variables identified by both uncorrected and corrected *P*-values should be evaluated' were followed. As such, an item was only considered non-invariant when identified by both uncorrected and corrected *P*-values. The effect sizes of the network loading difference were also examined.

In addition to Aboriginal and Torres Strait Islander identification (to evaluate cross-cultural validity), measurement invariance according to age was also investigated since maternal age was reported to be one of the main predictors of parental sense of competence (Shorey et al. 2015). If measurement invariance was established, the PSOC psychometric properties (such as dimensionality, model fit, etc) could be evaluated using the entire sample (containing both Aboriginal and Torres Strait Islander and non-Aboriginal and Torres Strait Islander Australians) and scores could be directly compared across groups (across Aboriginal and Torres Strait Islander and non-Aboriginal and Torres Strait Islander Australians). To compare the score distribution across groups, the probability density function of the PSOC subscale scores was estimated with Kernel density estimation and plotted. If measurement invariance was not

established, the PSOC psychometric properties had to be separately evaluated according to each subsample (separately for Aboriginal and Torres Strait Islander and non-Aboriginal and Torres Strait Islander Australians).

Model fit

The fourth step of the analysis was to evaluate model fit: whether the (estimated) network model (indicating the conditional associations between items and which are used to provide evidence on the validity of the instrument) provides a good description of the observed data. To evaluate the fit of the network model, the discrepancy function selected was the χ^2 statistic. The approximate fit indices root mean squared error of approximation (RMSEA) and comparative fit index (CFI) were used to indicate the degree of correspondence between the observed zero-order correlation matrix and the model implied zero-order correlation matrix (Kan et al. 2020). A recent simulation study showed that conventional guidelines from structural equation models (CFI $\geq$0.950 and RMSEA $\leq$0.050 indicate good model fit, and RMSEA $\geq$0.100 indicates unacceptable fit) are applicable to GGMs (Du et al. 2024). Furthermore, the fit of the network model was compared with the fit of the PSOC two-factor model (Efficacy and Satisfaction factors) estimated with confirmatory factor analysis (CFA) to indicate whether a network structure or factor structure is more suitable as the data generating mechanism (Kan et al. 2020). To enable a comparison with the network models, the CFA model was estimated with maximum likelihood (Epskamp 2023). The total entropy fit index using Von Neumann entropy (TEFI) was also employed to evaluate the partitioning of items into dimensions. The TEFI is a fit measure based on entropy that has superior accuracy (compared with RMSEA and CFI) in identifying the correct item partitioning into dimensions (Golino et al. 2020).

Criterion validity

The fifth step of the analysis was the evaluation of criterion validity. Concurrent validity between the PSOC and theoretically related measures was examined, including the PAFAS Parenting and Family Adjustment subscales, PSI Competence and Attachment subscales, EPDS and SDQ. Considering the ordinal nature of the measures, concurrent validity was examined with the non-parametric correlation coefficient Kendall's τ.

Reliability

The sixth step of the analysis was the evaluation of reliability. The McDonald's coefficient Ω was used to calculate internal consistency reliability. The McDonald's coefficient Ω is recommended over the traditional Cronbach's α because Cronbach's α has assumptions that are hardly met in practice, such as tau-equivalence (i.e. all items belonging to a certain dimension have the same loadings) (Dunn et al. 2014). Values of the McDonald's Ω above 0.70 indicate adequate reliability for research purposes.

Ethical approval

The SAABC received ethical approval from the University of Adelaide Human Research Ethics Committee (H-057-2010), the Aboriginal Health Council of South Australia (04-09-362), the South Australian Department for Health, and the Human Research Ethics Committees of three participating South Australian hospitals (Flinders Medical Centre: 435-10; Lyell McEwin Hospital: 2010-160; and the Women's and Children's Hospital: REC2322/11/13). The eMums study received ethical approval from the Women's and Children's Health Network Human Research Ethics Committee (SSA/16/WCHN/016, HREC/16/WCHN/014). This study was a secondary analysis of the SAABC and eMums studies and ethical approval was received for this analysis. All participants in the eMums and SAABC provided informed consent.

All procedures performed in both eMums and SAABC were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

The datasets generated and/or analysed during the current study are not publicly available since there is no permission from the ethics committee to publicly release the datasets of the South Australian Aboriginal Birth Cohort (SAABC) or eMums study in either identifiable or de-identified form.

Results

The participants' sociodemographic characteristics are displayed in Table 1. The two samples had differences in their sociodemographic characteristics. For instance, the findings indicated that a higher proportion of non-Aboriginal and Torres Strait Islander Australian mothers were older, had technical and/or tertiary education, and had employment as the source of household income. Among both the SAABC and eMums study, differences between the response sample and complete case sample were small and non-substantive.

Item redundancy, dimensionality and measurement invariance

Item redundancy, dimensionality and measurement invariance were evaluated in the full complete case sample (n=285) that included both Aboriginal and Torres Strait Islander (n=178) and non-Aboriginal and Torres Strait Islander Australians (n=107).

The first step of the analysis was the *estimation* of the network model, which will indicate how the items are (conditionally) associated and will be used to inform the validity of the questionnaire in the subsequent analyses (e.g. the number of clusters identified in the network will indicate the instrument dimensionality). The network model is displayed in Figure 2A; the nodes indicate items (referred to by their labels, see Supplementary Table) and the edges indicate partial correlations between two items. Positive partial correlations (i.e. edges) are displayed as blue lines and negative partial correlations (i.e. edges) are displayed as red lines. The size of the partial correlation (i.e. edge weights) is represented by the thickness and saturation of the edges. The nodes are coloured according to the dimension identified by EGA. For example, Figure 2A shows that the items *skills*

Characteristics at study baseline	SAABC		eMums	
	Response sample (n=221)	Complete case sample (n=178)	Response sample (n=108)	Complete case sample (n=107)
Maternal age – years				
<29	152 (71.0)	125 (73.1)	26 (24.1)	25 (23.4)
≥29	62 (29.0)	46 (26.9)	82 (75.9)	82 (76.7)
Missing	7	7	0	0
Education				
High school or less	155 (70.1)	121 (68.0)	12 (11.1)	11 (10.3)
Trade or university	66 (29.9)	57 (32.0)	96 (88.9)	96 (89.7)
Missing	0	0	0	0
Income				
Employment	29 (13.2)	25 (14.1)	100 (92.6)	99 (92.5)
Other	190 (86.8)	152 (85.9)	8 (7.4)	8 (7.5)
Missing	2	1	0	0

Data are provided as n (%).

Table 1: Sociodemographic characteristics of the participants

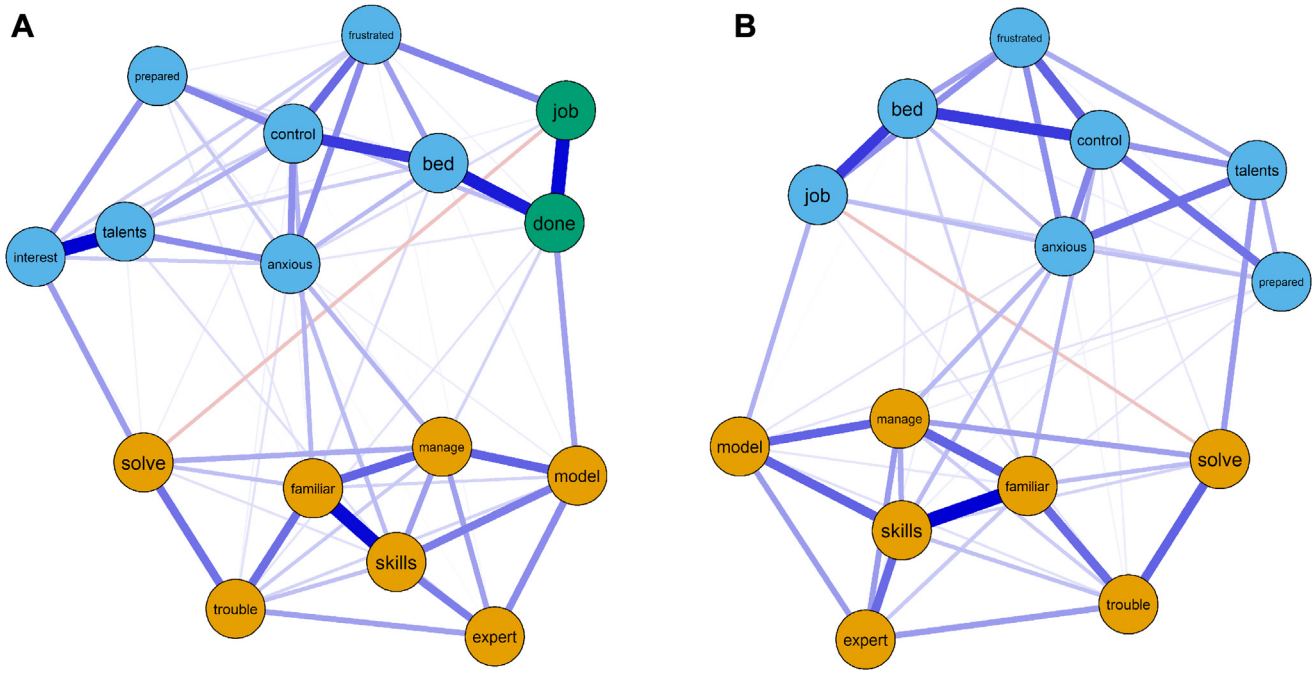


Figure 2: Network structure of the Parenting Sense of Competence Scale (PSOC). The nodes indicate the PSOC items and are referred to by their label (the labels for all PSOC items are displayed in the Supplementary Table). The edges indicate partial correlations. Positive edges are displayed as blue lines and negative edges are displayed as red lines. Edge weights are represented by the thickness and saturation of the edges. The nodes are coloured according to their exploratory graph analysis (EGA)-identified dimension. Panel A refers to the original 16-item PSOC and Panel B refers to the revised 14-item PSOC once item redundancy had been accounted for.

('I honestly believe I have all the skills necessary to be a good mother to my child') and *familiar* ('Considering how long I've been a mother, I feel thoroughly familiar with this role') established a positive partial correlation after controlling for all the other items in the network. Furthermore, the nodes *skills* and *familiar* are coloured blue, indicating that EGA identified the two nodes as belonging to the same dimension. The network in Figure 2A includes all 16 items of the original PSOC.

The evaluation of item redundancy indicated that two pairs of items had the wTO ≥0.25 and were potentially redundant: *talents-interest* (wTO=0.26) and *job-done* (wTO=0.25). The item *content examination* indicated that the items *talents* ('My talents and interests are in other areas, not being a parent') and *interest* ('If being a mother of a child were only more interesting, I would be motivated to do a better job as a parent') had strong conceptual overlap, so these items were considered redundant. For instance, both items seem to measure whether parenting was considered 'interesting'. There was also conceptual overlap between the items *job* ('A difficult problem in being a parent is not knowing whether you're doing a good job or a bad one') and *done* ('Sometimes I feel like I'm not getting anything done'). The content of both items revolved around the construct of performing tasks as part of parenthood. Due to conceptual (and statistical) overlap between these item pairs, these item pairs were combined into composite items. The composite item is referred from now on by the label of the first

item (for example, the composite item combining the items *talents* and *interest* is referred to as *talents*). After accounting for the redundancies, the revised PSOC included 14 items (12 items and 2 composite items) (Figure 2A).

Considering the original 16 items, EGA indicated a three-dimensional structure for the PSOC (Figure 2A). However, one of the dimensions (green nodes, see Figure 2A) included only the two redundant items (*job* and *done*) and was potentially induced due to latent confounding (since these two items measure the same behaviour). After redundancies were accounted for and the network included only items measuring unique behaviours, EGA indicated a two-dimensional structure (Figure 2B). The two-dimensional structure replicated exactly (considering the composite items) the original PSOC dimensionality, comprising the Satisfaction and Efficacy dimensions. The structural consistency of the Satisfaction (99.2%) and Efficacy (95.0%) dimensions was excellent. Item stability was also excellent and is displayed in Figure 3.

Network loadings are displayed in Table 2. All items from the PSOC displayed moderate to strong network loadings. Moreover, none of the items displayed cross-loading.

The analysis of measurement invariance indicated that configural invariance was achieved for all 14 items (12 items and 2 composite items) according to Aboriginal and Torres Strait Islander identification and maternal

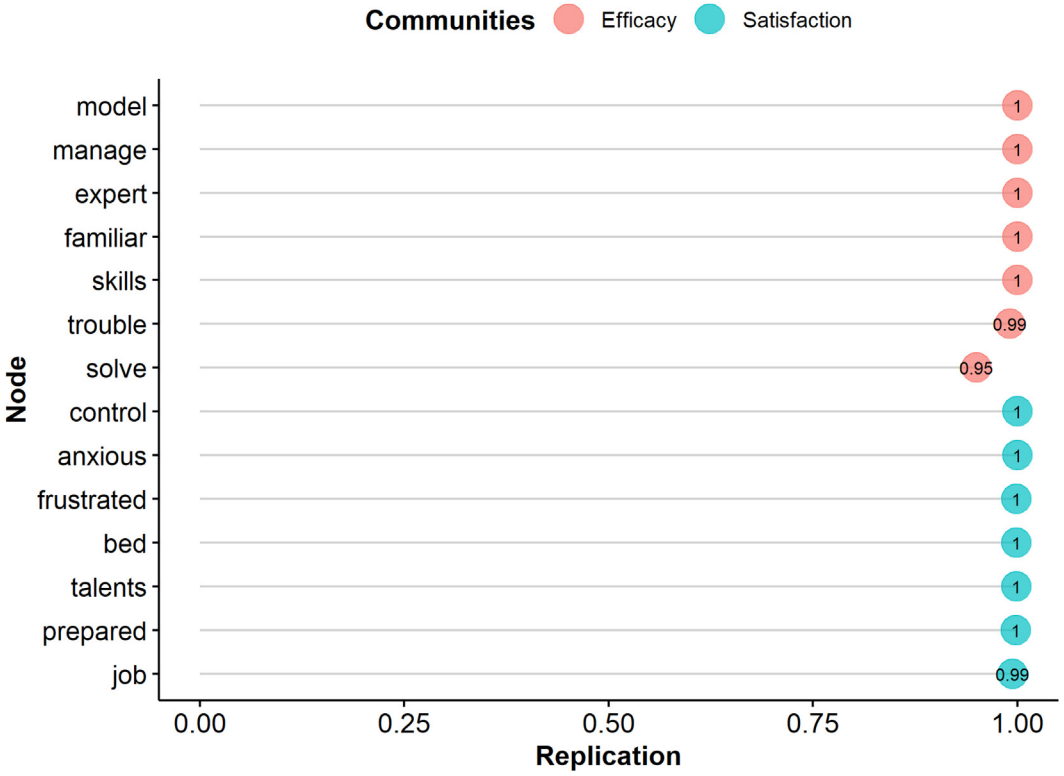


Figure 3: Item stability of the Parenting Sense of Competence Scale (PSOC). The *y*-axis indicates the items. The circles are coloured according to their exploratory graph analysis (EGA)-identified dimension. The *x*-axis indicates the proportion of times the item clustered with the EGA-identified dimension across the bootstrap samples.

Item	Efficacy dimension	Satisfaction dimension
skills	**0.40**	0.05
familiar	**0.38**	0.08
manage	**0.34**	0.05
trouble	**0.29**	0.03
expert	**0.26**	0.01
model	**0.25**	0.07
solve	**0.19**	0.09
control	0.06	**0.40**
bed	0.04	**0.31**
frustrated	0.01	**0.31**
anxious	0.09	**0.31**
job	0.06	**0.23**
talents	0.08	**0.23**
prepared	0.04	**0.20**

The dimensions were identified by exploratory graph analysis. Network loadings >0.15 (moderate loadings) are in bold.

Table 2: Network loadings of the Parenting Sense of Competence Scale

age. In the analysis of metric invariance according to Aboriginal and Torres Strait Islander identification and maternal age (Table 3), no items were identified as metric noninvariant by both uncorrected and corrected *P*-values (based solely on the uncorrected *P*-value, the item *manage* was identified as noninvariant according to Aboriginal and Torres Strait Islander identification and the item *control* was identified as noninvariant according to maternal age). That is: while non-negligible network loading differences ($\Delta\lambda$) between groups were observed for certain items (for the item *anxious*, the $\Delta\lambda$ was 0.209 between Aboriginal and Torres Strait Islander and non-Aboriginal and Torres Strait Islander Australians), this study was unable to reject the null hypothesis that these differences were due to sampling variation (i.e. sampling variation in case participants were randomly assigned to groups). Overall, these findings indicated that metric invariance was achieved.

Item	Aboriginal and Torres Strait Islander identification			Maternal age		
	$\Delta\lambda$	*P*	p_{BH}	$\Delta\lambda$	*P*	p_{BH}
skills	0.154	0.172	0.482	0.010	0.866	0.996
familiar	0.136	0.108	0.482	-0.102	0.164	0.574
manage	0.166	**0.022**	0.308	-0.020	0.790	0.996
trouble	0.012	0.872	0.872	0.079	0.296	0.691
expert	-0.071	0.344	0.672	-0.002	0.962	0.996
model	0.114	0.164	0.482	0.001	0.996	0.996
solve	-0.063	0.384	0.672	-0.178	0.122	0.569
control	0.060	0.566	0.792	0.210	**0.024**	0.168
bed	0.024	0.778	0.872	0.041	0.664	0.996
frustrated	0.015	0.860	0.872	0.006	0.942	0.996
anxious	0.209	0.054	0.378	0.009	0.938	0.996
job	0.076	0.346	0.672	-0.075	0.288	0.691
talents	0.051	0.456	0.709	-0.056	0.448	0.896
prepared	0.044	0.626	0.797	-0.277	0.010	0.140

Adjusted *P*-values (p_{BH}) were calculated according to the Benjamini-Hochberg multiple comparison procedure. Statistically significant *P*-values are in bold.

Table 3: Metric invariance of the Parenting Sense of Competence Scale according to Aboriginal and Torres Strait Islander identification

Since there was measurement (configural and metric) invariance according to Aboriginal and Torres Strait Islander identification and maternal age, the PSOC psychometric properties were further examined in the full sample (n=285).

Model fit

The evaluation of model fit indicated an excellent fit of the network model (Table 4). Based on the χ^2 statistic, the null hypothesis that the network model ($\chi^2(32) = 17.16$, $P = 0.985$) perfectly represents the true data-generating mechanism behind the PSOC item responses was not rejected, while the null hypothesis that the factor model ($\chi^2(76) = 103.19$, $P = 0.021$) perfectly represents the true data-generating mechanism was rejected. The TEFI was similar across both models since the EGA-identified dimensionality was equivalent to the PSOC theoretical dimensionality used as the configural model in the factor model (i.e. the two factors of Satisfaction and Efficacy). The CFI and RMSEA indicated an excellent fit of the network model (RMSEA $\leq$0.050; CFI $\geq$0.950) and superior fit compared with the factor model. In summary, while

Model	χ^2	*df*	*P*-value	Baseline χ^2	RMSEA	90% CI	CFI	TEFI
2-factor structure	103.19	76	0.021	1116.66	0.035	[0.015–0.052]	0.975	−8.90
Network structure	17.16	32	0.985	1166.66	0.000	[0.000–0.000]	1.000	−8.90

χ^2, chi-square; df, degrees of freedom; RMSEA, root mean square error of approximation; CI, confidence interval; CFI, comparative fit index; TEFI, total entropy fit index with Von Neumann entropy.

Table 4: Model fit of the revised Parenting Sense of Competence Scale (network and factor model)

the dimensionality structure was similar across both network (i.e. identified by EGA) and factor models (i.e. theoretical structure), resulting in a similar TEFI, the model implied zero-order correlation matrix from the GGM better explained the observed zero-order correlation matrix than the model implied zero-order correlation matrix from the factor model.

Criterion validity

The PSOC associations with theoretically-related measures are displayed in Figure 4. The PSOC Efficacy and Satisfaction subscales displayed the expected negative associations with the PAFAS Parenting and Family Adjustment subscales, the PSI Competence and Attachment subscales and the EPDS. For example, mothers who reported a higher parenting sense of competence (higher scores on the PSOC Efficacy subscale) also reported lower postnatal depression (lower scores on the EPDS) and vice versa. The PSOC Efficacy displayed the expected positive association with the NCAST – Caregiver (indicating higher levels of positive mother-child interaction quality). The only exceptions were the associations between the PSOC Efficacy and Satisfaction subscales with the SDQ, which instead of negative were weak and non-substantive.

Reliability

The internal consistency reliability of the Efficacy subscale (Ω = 0.78; 95% CI 0.74–0.82) was adequate,

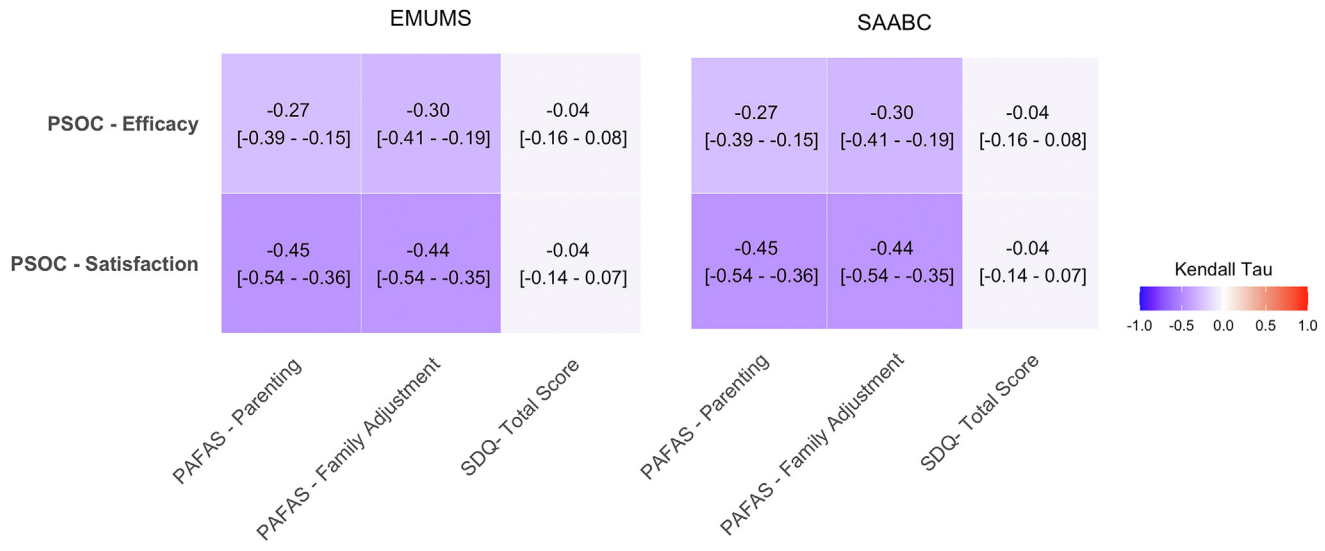


Figure 4: Criterion validity of the Parenting Sense of Competence Scale. Point estimates indicate correlations and values in square brackets indicate the 95% confidence interval for each correlation. Purple shades indicate negative correlation, white shades indicate no correlation and red shades indicate positive correlations. The saturation of the colour indicates the strength of the correlations (i.e. stronger shades of purple indicate stronger negative correlations).

while the internal consistency reliability of the Satisfaction subscale was good (Ω = 0.82; 95% CI 0.78–0.86).

Group comparisons

Considering that measurement invariance was established according to Aboriginal and Torres Strait Islander identification and maternal age, the score comparison between groups is reported in Figure 5. Aboriginal and Torres Strait Islander carers and younger carers (age <29 years) had a higher parenting sense of competence (considering both mean subscale scores and the probability density of the subscale scores distribution) (Figure 5).

Discussion

This study aimed to evaluate the cross-cultural validity of the PSOC between Aboriginal and Torres Strait Islander and non-Aboriginal and Torres Strait Islander Australian mothers. The findings indicated that the PSOC displayed measurement invariance between Aboriginal and Torres Strait Islander and non-Aboriginal and Torres Strait Islander Australians (and

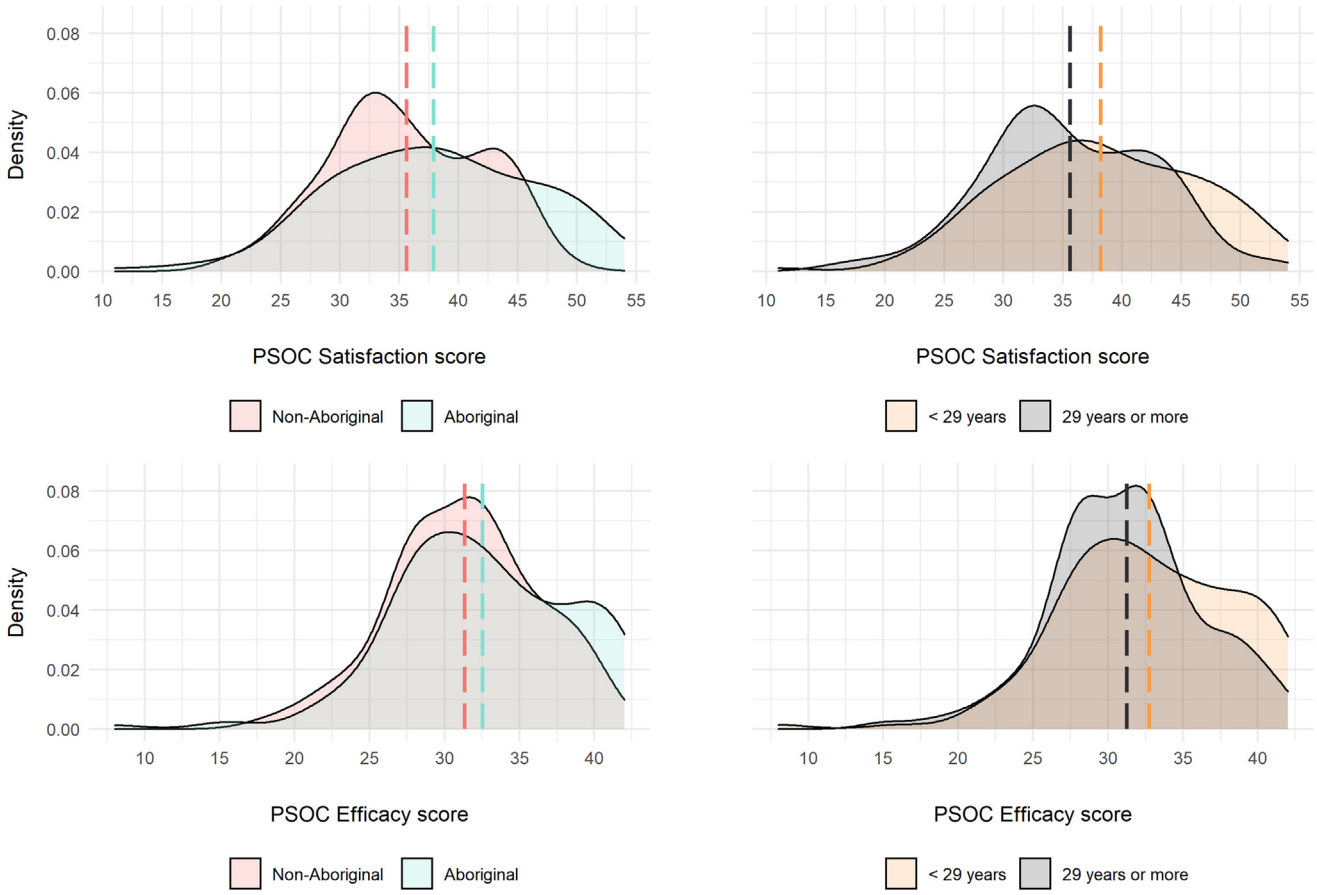


Figure 5: Probability density of the Parenting Sense of Competence Scale (PSOC) scores across groups. The *x*-axis indicates the observed PSOC subscale scores. The *y*-axis indicates the probability density. The dashed lines indicate mean subscale scores and are coloured according to each group.

according to maternal age). The implication is that the PSOC scores can be used to provide direct comparisons between Aboriginal and Torres Strait Islander and non-Aboriginal and Torres Strait Islander Australians and score differences will reflect true differences in parenting sense of competence rather than cultural bias.

Dimensionality and redundancy

This study provided empirical evidence that the 14-item PSOC displayed the two theoretical dimensions, Efficacy and Satisfaction, and these dimensions have been identified by other validation studies of the PSOC across multiple countries (but not in Indigenous countries) (Jankowska et al. 2022; Johnston and Mash 1989; Ngai et al. 2007; Ohan et al. 2000; Oltra-Benavent et al. 2020).

The original dimensionality analysis on the 16-item PSOC indicated three factors (Efficacy, Satisfaction and Interest), including a third factor comprising the items *job* ('A difficult problem in being a parent is not knowing whether you're doing a good job or a bad one') and *done* ('Sometimes I feel like I'm not getting anything done'). The three-factor structure is consistent with previous validations of the PSOC among Australian caregivers, which also identified an extra third factor (Gilmore and Cuskelly 2009; Rogers and Matthews 2004). However, the redundancy analysis in this study indicated that this item pair (*job* and *done*) displayed strong redundancy, and further item content examination confirmed a strong conceptual overlap between these two items (centring on the idea of performing tasks as part of parenthood). The redundant items clustered together and form a minor factor, leading dimensionality analysis methods such as EGA to *overfactor*, to identify three factors (instead of two factors) even considering that the factor comprising the redundant items is not substantively meaningful (Flores-Kanter et al. 2021). As such, after redundancy was accounted for, the dimensionality analysis (on the 14-item PSOC) recovered only the two theoretical factors of Efficacy and Satisfaction.

Regarding the two redundant items, there are three potential alternatives for future use of the PSOC in Australia. Firstly, it is possible to remove one of the redundant items for each item pair. Strategies to choose which item from the redundant pair to retain include keeping the most general item (the item that better covers the measured behaviour), the item with the highest corrected item-total correlation or the item with the highest score variance. Secondly, it is possible to develop a new item that incorporates information from both items in the redundant pair (Christensen et al. 2020). These two alternatives (deletion or writing of a new item) would result in a revised 14-item PSOC. A third alternative would be to maintain the original 16-item PSOC with the redundant items. However, the two redundant items introduce an additional response burden (Reeve 2003). Moreover, if research aims to evaluate the 16-item PSOC psychometric properties, these two redundancies should be accounted for, since redundancies lead to problems regarding dimensionality identification (Flores-Kanter et al. 2021) but also inflated internal consistency reliability. It is recommended that further research on the cultural validity of the PSOC should consult with Aboriginal and Torres Strait Islander community members, leaders and Elders, researchers, and health professionals, among other stakeholders, to inform how to best handle the redundant items (e.g. which item should be deleted, how to write a culturally-appropriate item, whether both items should be retained).

Criterion validity and group comparisons

The evaluation of criterion validity provided evidence that the PSOC displayed the expected associations

with theoretically related measures. Furthermore, considering that measurement invariance was established according to Aboriginal and Torres Strait Islander identification and maternal age, the group score comparisons indicated that Aboriginal and Torres Strait Islander and younger mothers had on average higher levels of parenting sense of competence.

These findings highlight the strength found in Aboriginal and Torres Strait Islander child-rearing practices, which are broader than Western practices (Ryan 2011). Notably, Aboriginal and Torres Strait Islander mothers report that the strength of their child-rearing practices comes from the continuing support of the extended family and community, the cultural knowledge shared across generations, and the connection to Country (e.g. birthing on Country) (Dunstan 2021; Marriott et al. 2019). Overall, these connections are fundamental in promoting a high parenting sense of competence among Aboriginal and Torres Strait Islander mothers (Massi et al. 2023). In contrast, the predominant Western conceptualisation of family is the nuclear family, which comprises (in most cases) two parents and their children (Dunstan 2021) and the parenting responsibilities are primarily attributed to the mother (Lindstrom 2016). In certain circumstances, the absence of support from a larger community in Western cultures can make parents become overwhelmed with parenting responsibilities and lead to a decreased parenting sense of competence (Lindstrom 2016).

When researching Aboriginal and Torres Strait Islander child-rearing practices, it is fundamental to consider that Aboriginal and Torres Strait Islander communities comprise highly heterogeneous cultural groups with equally diverse parenting practices (Reay 1988). For instance, in the SAABC, the mothers belonged to several distinct tribal groups, language groups or clans such as Kaurna, Ngarrindjeri, Adnyamathanha and Barngarla, among others. Furthermore, the SAABC includes only Aboriginal and Torres Strait Islander mothers residing in SA and, in most cases, participants belonging to cultural groups located outside SA were not part of the study. For these reasons, future research should also investigate the validity of the PSOC for specific Aboriginal and Torres Strait Islander cultural groups to understand potential differences regarding parenting practices and their impact on the instrument validity.

Furthermore, an increased parenting sense of competence was observed among young mothers. The evidence from most studies indicates that older mothers experience a higher parenting sense of competence (Glatz et al. 2024), contrary to the evidence from this study. One potential reason is that older women have more life experience and developed more skills to cope with parenting challenges (Zhu et al. 2022). However, there are studies that report that younger (and often first-time) mothers experience higher parenting satisfaction (Curci et al. 2021; Grady and Karraker 2017), similar to the evidence from this study. The reason is that older mothers might have more children, contributing to increased responsibilities and parenting stress, lessening the satisfaction derived from the parenting role (Curci et al. 2021). Overall, reviews have indicated that the current research evidence on the effects of paternal characteristics (e.g. age) on parenting sense of competence is not strong (due to the cross-sectional design of most studies) and more longitudinal studies are required to understand these effects (Fang et al. 2021). In Australia, future studies should further investigate the levels of parenting sense of competence according to maternal age in Aboriginal and Torres Strait Islander and non-Aboriginal and Torres Strait Islander populations.

Finally, the measures used to evaluate criterion validity in this study were Western-developed instruments (e.g. Strengths and Difficulties Questionnaire) and future research will also benefit from evaluating criterion validity with instruments that are specifically designed to capture Aboriginal and Torres Strait Islander perspectives.

Strengths and limitations

This study had several strengths. For instance, while other studies reported on instruments that were not cross-culturally valid in Australia (Ribeiro Santiago et al. 2020), it is believed that this is the first study that provides evidence of a psychological instrument that displayed measurement invariance between Aboriginal and Torres Strait Islander and non-Aboriginal and Torres Strait Islander Australians.

This study also had limitations. Firstly, while the SAABC constitutes one of the largest Aboriginal and Torres Strait Islander birth cohorts in Australia (Jamieson et al. 2021), due to this study's medium sample size, it was decided to not split the sample into development and validation samples. Splitting the sample was avoided to maintain the maximum statistical power for the estimation of the GGMs. However, the disadvantage is that the network/factor models were estimated and model fit was evaluated on the same sample, so model fit indices were potentially inflated (Fokkema and Greiff 2017). Future studies should evaluate the fit of the PSOC network model in independent samples to confirm the excellent model fit. Conducting future studies with larger samples will also provide more power for the permutation testing to detect non-invariant items, rejecting the null hypothesis that non-negligible network loading differences were due to sampling variation (when these network loading differences were truly due to non-invariance) (Jamison et al. 2024).

Secondly, while the permutation testing procedure employed to evaluate measurement invariance provided evidence of (non-)invariance at an item level (i.e. differential item functioning), it can only evaluate invariance across two groups (Jamison et al. 2024). Future studies should develop methods that consider the combinations of multiple variables (e.g. recursive partitioning and tree models; Jones et al. 2020). Thirdly, the eMums study and SAABC evaluated parenting sense of competence at different stages of motherhood (when children were aged approximately 1 year and 5 years, respectively). Considering that research evidence is unclear on whether children's age impacts parenting sense of competence (Fang et al. 2021; Glatz et al. 2024), future studies should further evaluate cross-cultural invariance of the PSOC among Aboriginal and Torres Strait Islander and non-Aboriginal and Torres Strait Islander mothers of children with a similar age.

Finally, it is known that parenting practices and parental sense of competence are influenced by culture (Crijnen et al. 1997). While the PSOC displays good psychometric properties for Aboriginal and Torres Strait Islander mothers and is cross-culturally invariant, it is still a Western-developed instrument and it was not expected that the dimensions of Efficacy and Satisfaction necessarily cover all the dimensions that explain parenting sense of competence among Aboriginal and Torres Strait Islander mothers. As such, while the PSOC can be used among Aboriginal and Torres Strait Islander mothers, future research is encouraged to qualitatively investigate the dimensions that best represent parenting sense of competence among Aboriginal and Torres Strait Islander mothers (Brown et al. 2016) and then develop a culturally-specific instrument to measure parenting sense of competence among Aboriginal and Torres Strait Islander mothers (Gilchrist et al. 2023).

Conclusion

The PSOC is the most widely used psychological instrument to measure parenting sense of competence worldwide. This study was the first to evaluate the cross-cultural validity of the PSOC among Aboriginal and Torres Strait Islander and non-Aboriginal and Torres Strait Islander Australians. After accounting for item redundancy, an adapted 14-item version of the PSOC displayed excellent psychometric properties and cross-cultural invariance. The 14-item PSOC is readily available to be used in Australia.

Author contributions

P. H. Ribeiro Santiago: Conceptualisation, methodology, software, formal analysis, investigation, writing - original draft, visualisation. A. Sawyer: Conceptualisation, methodology, validation, formal analysis, investigation, resources, data curation, writing - original draft, supervision, project administration, funding acquisition. M. Sawyer: Conceptualisation, validation, resources, data curation, writing - review and editing, supervision, project administration, funding acquisition. L. Jamieson: Conceptualisation, validation, resources, data curation, writing - review and editing, supervision, project administration, funding acquisition. J. Hedges: Conceptualisation, validation, resources, data curation, writing - review and editing, supervision, project administration.

Data sharing

The pre-print of this manuscript is available at the PsyArXiv: https://psyarxiv.com/aktxd/. The datasets generated and/or analysed during the current study are not publicly available since we do not have permission from the ethics committee to publicly release the datasets of the South Australian Aboriginal Birth Cohort (SAABC) or eMums study in either identifiable or de-identified form. The datasets are available from the corresponding author on reasonable request.

Declarations of interests

The authors declare no competing interests.

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Supplementary material

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.fnhli.2025.100058

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