**Introduction/Background**

Research practices across a range of scientific fields have been subject to critique over recent years (Grand et al., 2018; Kepes & McDaniel, 2013; Miller, 2022; Stroebe et al., 2012; Vazire, 2018). Research in the field of Psychology in particular has seen growing concerns with regards to flexible data collection, analysis, and reporting (Open Science Collaboration, 2015; Simmons et al., 2011). In response to what has been called a ‘crisis of confidence’ in the field of psychology (Miller, 2022), we are confronted with a ‘credibility revolution’ which calls for greater methodological rigour (Vazire, 2018). This includes greater transparency and openness, preregistration, more direct replications, and the need for higher standards of evidence before strong claims can be made (Vazire, 2018).

Causal inference is another area of focus amidst this revolution. ‘Correlation does not imply causation’ is professed in laboratories and undergraduate lectures alike, cautioning researchers and students against drawing unjustified causal conclusions from non-experimental evidence. However, rather than encouraging due diligence, explicit causal inference has been subject to a taboo which can result in mixed messages and obscured research goals where researchers still implicitly ask causal research questions and draw conclusions based on causal inference (Grosz et al., 2020). Credible, cumulative science depends upon transparency (Grand et al., 2018). The clarity of causal implications has important implications for the implementation of research findings. Causal inference from non-experimental data is difficult, but not impossible (Haber et al., 2018); it depends upon transparency in the goal of causal inference and in the assumptions underlying research decisions (Grosz et al., 2020), which would ensure that studies with implicit causal objectives are held to the same rigorous standards of evidence as those which are explicitly causal.

The use of ambiguous causal language can implicitly convey causal relationships, risking the overstatement of findings (Thapa et al., 2020). While researchers typically avoid explicit causal inference in non-experimental research (Alvarez-Vargas et al., 2020), they may imply or intend to draw a causal link between an exposure and outcome while avoiding causal language, leading to a disconnect between research findings and their interpretation (Grosz et al., 2020). This applies to action recommendations and claims that require a causal interpretation to make sense (Haber et al., 2021), which has important implications for decision-makers and policy makers (Grosz et al., 2020). The general population has been found to be prone to inferring causation from correlation (Bleske-Rechek et al., 2015), and studies which use ambiguous causal language have been shown to be perceived as higher quality than those which use straightforward causal language, as well as providing similar or greater support for subsequent policy recommendations (Alvarez-Vargas et al., 2020). Moreover, observational study results have been found to often be extended to recommendations for medical practice despite unsuitable study designs, without acknowledging the need for a RCT (Prasad et al., 2013). The prevalence of ambiguous causal language and disconnects between researchers’ intentions and subsequent claims have been explored in health psychology (Haber et al., 2018), and several studies have attempted to categorise terms in publications by strength of causal implications (e.g. Adams et al., 2017; Buhse et al., 2018; Parra et al., 2021). However, this phenomenon has not been investigated in the context of industrial-organisational (IO) psychology.

The aforementioned crisis of confidence extends to sub-disciplines of psychology, including IO psychology (Efendic & Van Zyl, 2019; Kepes & McDaniel, 2013). Questionable research practices and misconduct have been identified and critiqued in IO research in recent years (Banks et al., 2016; Bedeian et al., 2010; Efendic & Van Zyl, 2019). With rapidly growing membership in the IO community and the inherent opportunity to tangibly impact employees, organisations, and societies as a whole, checks and balances on research practices are essential to protect the credibility of the IO field (Grand et al., 2018). Thus, logical leaps such as those identified by Prasad et al (2013) in a health psychology context pose a significant threat to the credibility and validity of IO psychology.

The present study is a conceptual replication and extension of Haber at al.’s (2021) study which investigated the use of linking language in high-profile health literature. Here, we are applying their research questions to psychological capital, an increasingly popular construct in the management and IO literature proposed by Luthans et al. in 2004. Psychological capital consists of the combined psychological resources of self-efficacy, hope, optimism and resilience (Luthans et al., 2004), and has been found to be associated with numerous positive outcomes including increased wellbeing (Gautam et al., 2019), life satisfaction (Santisi et al., 2020), job satisfaction (Luthans et al., 2007), organisational commitment and turnover intentions (Luthans et al., 2004), making psychological capital an attractive construct for targeted interventions by organisations eager to optimise their employees’ psychological wellbeing and performance (Schaufeli & Taris, 2014). As psychological capital rises in popularity, we are provided with an opportunity to understand the prevalence of inappropriate linking language and invalid causal reasoning in the existing research, with the hope that if disconnects are identified, increased transparency and greater alignment between research findings and causal implications can be promoted.

This study will be a small-scale review of the psychological capital literature to evaluate the causal nature of linking language within this literature. It will also assess the prevalence of disconnects between language used and action recommendations made, and whether causal inferences are transparently acknowledged.

It should be noted that this pre-registration uses content from Haber et al.’s original pre-registration, available on OSF. Their OSF project has a CC-By Attribution 4.0 International license, allowing for the reproduction and sharing of this content, and permission has been given by the primary author (N. Haber) to use the publicly available materials.

**Objectives/Research Questions**

Primary Objectives:

1. Identify the linking words and phrases used to describe relationships between predictors and outcomes in psychological capital literature
2. Generate estimates of the strength of causality stated or implied by the linking phrases and sentences in the psychological capital literature.
3. Examine the prevalence of action claims, recommendations, and other implications that would require causal inference to have been made
4. Examine the prevalence of misalignments between causal implications of linking language and subsequent action implications.

Secondary Objectives:

1. Examine whether studies contain a transparent acknowledgement of an intent to draw causal inferences
2. Examine whether studies contain explicit causal disclaimer statements, and whether causal links are implied anyway
3. Examine whether the authors explicitly used any strategies to increase credibility of causal inferences, such as explaining the intent of controlling/adjusting for a variable.

**Definitions**

This review will employ the following definitions, as per Haber et al.’s (2021) project, with some departures to suit this present study where applicable:

Predictor/independent variable

For this study, "independent variable” or “predictor” refers to the independent variable of interest (in a regression sense) or the primary or antecedent variable being investigated for a possible (non-) causal link to the study outcome, or resulting or end-point variable. It may be labelled by terms such as exposure, factor, protective factor, determinant, intervention, correlate, predictor, cause, or other terms recognised in the field as referencing predictor/independent variables.

Outcome

"Outcome" refers to the dependent or effect variable of interest that is being investigated for a possible link to the predictor variable. It is typically assumed or known to be preceded by the predictor. It is sometimes called the study endpoint variable, response variable, consequence, result, and other recognised terms.

Linking words/phrases

A word or phrase that describes the nature of the connection between some defined predictor and some defined outcome, generally used in a sentence containing both predictor and outcome. For our purposes, the phrase may contain 1-3 words in the case where one of the words is a preposition to link the predictor and outcome. Examples (linking word in italics):

* We found that X was *associated with* a 2.1 relative risk increase of Y
* The *effect* of X on Y was 7%
* X *increased* Y
* We did not find a statistically significant *link* between X and Y
* X was *correlated with* a 20% reduction in the odds of Y
* The *impact* of policy change x on outcome y
* The *benefit/harm* of doing/abstaining from health behaviour x on outcome y
* The *predictors* of outcome Y were X, Z
* X is a *risk* (or *protective*) factor for Y
* X is a *protective factor* for Y
* *Influence* of X on Y
* X was a *determinant/determining factor* for Y
* X and Y were positively *correlated*
* X *exacerbated* (or *attenuated*) Y
* X *modified the risk* of outcome Y
  + Note: *modified* is also used in causal inference circles in ways that are not necessarily (but may be) linking words as we have described them (Rohrer & Arslan, 2021).

Linking word/phrase modifier words/phrases

A word or phrase that modifies the relationship between the predictor and outcome. This includes adding signals of direction, strength, or doubt to the relationship using phrases such as “may be,” “positively,” “strongly”, “potentially”, “is likely to…” etc. Phrases that refer to statistical concepts (e.g. “statistically significant”) and/or practical significance (e.g. “clinically significant”) will also be collected separately.

Causal linking word/phrase

Causal language implies that one entity influences another. This can be expressed through multiple means, including verbs that imply that movement (or lack thereof) in the outcome was impelled by the predictor of interest (e.g., increase, decrease, improve, changed) but also conjunctions that imply attribution of the outcome to the predictor (because, due to, since) (description adapted from Thapa, et al., 2020). Such causal linking words or phrases may also be further modified to make them appear weaker ("may", "could", "can") without sacrificing the causal implication.

Causal implication of recommendations

Action recommendations are descriptions of how a consumer of research might utilise the results and conclusions of the research. Recommendations may often imply a causal interpretation of a finding. For example, authors may suggest that it could be beneficial to change the amount of a predictor, which rests on the assumption that the predictor has a causal effect on the outcome. As a variation, it may also be suggested that a predictor need not be changed, which rests on the assumption that the absence of a causal effect has been established.

**Methods**

This study is a small-scale analysis of language used in the psychological capital literature. Our target sample is studies published on psychological capital in an organisational context since 2016 concerning the relationship between a predictor and outcome.

Inclusion / exclusion criteria

* Articles sourced using key words search in Scopus
  + The full text must be available
* Published between 2017-2022
* The primary research question must be concerned with the relationship between psychological capital and one or more other variables, in which psychological capital is a predictor variable or outcome variable
  + Studies in which are only concerned with psychological capital as a mediator or moderator will not be included
* The primary research question must be examined quantitatively using primary data
  + The main study design must not be a review or meta-analysis, or other secondary study design
* The study must be observational (i.e., non-experimental) in design, including longitudinal studies. Quasi-experimental studies will not be included
* The study must focus on psychological capital in an organisational context.

Note that prior to the finalisation of this pre-registration, search results in Scopus had been reviewed and some articles read. This was to understand what the inclusion criteria should specify to include a broad range of psychological capital studies to which the review tool could be applied.

Phase 1: Initial study selection

A simple search will be performed on Scopus for articles published in the subject areas Business, Management and Accounting, Psychology or Social Science since 2016 featuring the key words “psychological capital” in the article title, using the following terms:

TITLE ( psychological  AND capital )  AND  PUBYEAR  >  2016  AND  ( LIMIT-TO ( DOCTYPE ,  "ar" ) )  AND  ( LIMIT-TO ( SUBJAREA ,  "BUSI" )  OR  LIMIT-TO ( SUBJAREA ,  "PSYC" )  OR  LIMIT-TO ( SUBJAREA ,  "SOCI" ) )

The search will be limited to the subject areas of Business, Management and Accounting, Psychology, and Social Science as these are the three subject areas with the most articles published on psychological capital, and these fields all relate to psychological capital as an industrial-organisational concept. Only articles which reference “psychological capital” in their title will be included to help filter out articles in which the construct is not a variable. The search will include articles since 2017 as this is where the number of published articles per year relating to psychological capital can be seen to increase rapidly (see Figure 1).

**Figure 1**

*Psychological Capital Articles Published by Year*

*Note.* Number of articles published on Scopus in the subject areas of Business, Management and Accounting, Psychology or Social Science since 2016 featuring the key words “psychological capital” in the article title. Sourced from Scopus search results analysis on May 5th 2022.

Phase 2: Screening and selection

The titles and abstracts of articles entering this phase will then be screened for inclusion. Articles will be screened in the order they appear in the Scopus search results, with accept/reject decisions made for each until 52 articles have been accepted. 2 of these articles (the first two accepted) will serve as training articles, where the following data extraction protocol will be trialled.

The sample size of 50 (plus an additional 2 for training) has been selected for a margin of error of 15% in estimates of proportions at the 95% confidence level. The margin of error for proportions is being used as the basis for sample size determination because of the descriptive focus of this study.

Phase 3: Data extraction

An adapted version of Haber et al’s (2021) review tool will be employed in this study. Prior to data extraction, I will go through the review tool and 2 training articles in detail along with my primary supervisor to discuss intent and application of each review question. I will have reviewed the 2 training articles independently prior to this meeting.

Data to be extracted by review

Titles and abstracts will be examined for all studies in our sample, and one third of the studies (n=20) will have their full text reviewed, using a full text version of the review tool, which will also examine language and other items in the main text. This full text review is limited to 1/3 of the sample due to feasibility within the time limitations of this study. In that full text review, data will come from two sources in the study document: the title/abstract, and the discussion/conclusion sections in the main text. The following information will be determined from (1) the title and abstract, and (2) the main text discussion (if one of the 1/3 of articles that get full text review):

* The primary variable of interest of the study
  + “Primary” may be determined by any combination of the title and abstract, with higher weights toward items in the title and/or conclusion sections
  + Limited to a phrase or a few words
* The primary outcome of interest of the study
  + “Primary” may be determined by any combination of the title and abstract, with higher weights toward items in the title and/or conclusion sections
  + Limited to a phrase or a few words
* The sentence(s) containing the main linking phrase(s) between predictor and outcome in the relevant location (title, abstract, full text, and pop-out section)
  + This study will extract one key phrase per title, abstract, and full text
  + The reviewer will select the most prominent sentence containing reference to the primary predictor, primary outcome, and with a linking word/phrase, with order of preference as follows:
    - For the abstract review, the order of preference for locating the most prominent sentence is discussion/conclusion section, results, or introduction section
      * If the abstract does not have these sections, the most prominent concluding sentence will be located
    - For the full article review, the order of preference for location will be the first paragraph in the discussion, the rest of the discussion, and the results section.
* The key linking word phrase
  + One will be selected per title, abstract, and main text as the main linking phrase; they may or may not match
* Modifiers of the linking word/phrase
  + Any phrases that demonstrate strength, weakness, or doubt about the robustness of the linking phrase
  + Examples (modifying phrase in italics)
    - “There may be a relationship between”
    - “We find that X is strongly associated with”
* The degree to which the linking words/phrases imply causality will be assessed on an ordinal categorical scale. (e.g. no implication, weak implication, some implication, strong implication)
* Sentence(s) containing implications for actions by decision-makers
  + Any sentence in abstract or discussion which contains action claims for decision-makers
  + Example
    - “Therefore X may be an important strategy to improve…”
* Subjective assessment of whether the action claims (i.e. what should be done with the results of the analysis) imply, require, or are predicated on the assumption that a causal estimation had been made
  + This is largely based on whether the paper suggests changing the amount of the predictor variable (increase, decrease, stay the same, or ambiguously directioned impact) in order to modify or keep the amount of the outcome the same
    - For example, the phrase “Meditating is safe for mental health” requires causality to have been inferred, as it suggests modification of meditation to achieve an outcome goal.
  + The degree to which the action's implications imply causality will be assessed on an ordinal categorical scale. (e.g. no implication, weak implication, some implication, strong implication)
  + In the case that there are multiple stated action claims, the implication with the strongest implications will be chosen
  + Any action claims that did not require causality to have been inferred, such as for targeting purposes, documentation of disparities, prediction without causation, etc., will be identified
* Extract basic methodological information
* Does the main specification control/adjust for anything?
* Do the authors discuss confounding factors?
* Is a causal theory presented in the introduction?
* Are any causal models (e.g. DAG, narrative discussion of causal processes, toy equation models, structural equation) presented in the introduction or discussion? A draft data extraction form is attached to this protocol. Extraction form may change after piloting.

A draft review tool is attached to this pre-registration.

**Analysis**

Statistical Analysis

Statistical analyses in this study will primarily be descriptive (e.g. describing the distributions of key extracted variables). For differences in proportions for key metrics (e.g. degree of causality implied by linking words and/or action claims) between abstracts and text and any other bivariate models, simple differences in proportions and/or relative proportions will be estimated and reported with 95% confidence intervals.

Main outcomes measures for each objective

*Identify the associational linking words:*

This will consist of gathering the proportion of linking word/phrase and reporting the count of the number of times these appear and proportions with a 95% CI. These will be reported separately for the abstract and the main text.

*Generate estimates of the degree to which linking words and phrases state or imply causality in the psychological capital literature:*

The identified linking words/phrases will be rated against the four categories of causal implication. The proportion of linking words/phrases in our sample in each of the four categories will be reported.

*Examine the prevalence of recommendations and action claims, as well as other implications, that would require causal inference to have been made:*

We will report the proportions of strength of action implication language for the abstracts.

*Examine the prevalence of misalignment between the language used to describe relationships and implications subsequently drawn:*

The conceptual and statistical basis for this will be the difference in the distribution of causal linking words/phrase categories with the distribution of causal action implications. We will firstly plot (most likely via heat map or similar) the crosstabs of causal linking words vs. causal action implication ratings. Secondly, we will formally estimate the relationship between the strength of the causal linking word and the action recommendation a two-tailed Spearman’s rho rank test at a 5% alpha level. Additionally, we will calculate the proportion of articles where the causal strength of the action implication language is stronger than the causal strength of the linking word.

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