# Examining Linking Language and Causal Implications in Observational Psychological Capital Research

A thesis presented in partial fulfilment of the requirements for the degree of

Master of Science in Psychology

at Massey University, Albany, New Zealand.

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2023

Abstract

The present study is a small-scale conceptual replication of Haber et al.'s (2022) study which examined how causal and associational language is used in observational health research, applied here to the domain of psychological capital. Psychological capital is an increasingly popular area of research in the industrial-organisational psychology (IO) field. We use this construct to examine whether the issues with implied causal inference identified by Haber et al. extend to the field of IO psychology. Specifically, we evaluate the causal strength of linking words, which are the words or phrases used to describe the nature of the connection between some defined independent variable and some defined outcome variable, linking sentences, which are the sentences that contain these linking words, and action recommendations. Causal language is that which implies one entity influences another. Our results highlight that both explicitly causal and non-causal linking words are commonly used in the observational psychological capital literature, including "relate", "influence", "impact", and "effect". The majority of primary linking sentences implied some level of causality, despite the fact that very few articles explicitly stated an intent to estimate causal effects and many explicitly warned against drawing causal inferences. Additionally, the majority of action recommendations had strong causal implications. No significant relationship was found between the causality implied in the linking sentences and the strength of causal implication of the action recommendations. Overall, causality appears to often be implied within the observational psychological capital literature, risking the overstatement of the evidence base. This has important implications for how research is implemented, and very real consequences for those who are the subject of such implementations. Recommendations are made for how authors, reviewers, and research consumers can support valid causal reasoning in observational research. Ultimately, through increased transparency and being

cognisant of implied causality, we can ensure the credibility of the findings and the integrity of applications of the observational psychological capital literature.

Acknowledgements

I would like to thank my exceptional supervisors, Dr. Matthew Williams, and Dr. Dianne Gardner, of the School of Psychology, Massey University. As my primary supervisor, Dr. Williams' passion for metapsychology strongly shaped my interest in this area of research, and it was with his encouragement that I stepped outside my comfort zone in pursuing this thesis topic. Dr. Gardner's expertise in industrial and organisational (IO) psychology was indispensable in applying these metascience concepts to the domain of IO psychology. It has been a privilege to be guided by their wisdom and experience. Thank you for your patience, honesty, and invaluable feedback.

I am eternally grateful for the unwavering support of my family and friends over the last several years. Thank you to my parents for all the opportunities that they have worked so hard to provide. Thank you to my father, Stephen, who has diligently read almost every piece of writing that I have submitted during my seven years of university study. To my mother, Carlyn, and my sister and best friend, Alana: thank you for believing in me wholeheartedly. To my partner, Aaron: thank you for your patience, encouragement, and for reminding me that I can do hard things. I am incredibly lucky to be surrounded by so much love.

Finally, I would like to gratefully acknowledge Massey University for providing me with the Massey University Master's Research Scholarship.

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# Introduction

## The 'Credibility Revolution' and the Role of Meta-Psychology

Over the last decade, the trustworthiness of research practices across a range of scientific fields has been called into question (Grand et al., 2018; Kepes & McDaniel, 2013; Miller, 2022; Stroebe et al., 2012; Vazire, 2018). Substantial quantitative evidence suggests that scientific methods are suboptimal within psychology and across other disciplines which exhibit similar statistical variability (Miller, 2022). The fraud case of Diederik Stapel in 2011 cast doubt upon the field of social psychology in particular, prompting a series of scathing articles to be published in the international press (see St`roebe et al., 2012). This followed the publication of Daryl Bem's 2011 study which reported evidence of psychic abilities in the *Journal of Personality and Social Psychology*, receiving widespread mockery (Pashler & Wagenmakers, 2012). Simmons et al. (2011) added fuel to the fire when they published an article demonstrating how questionable research practices such as flexible data collection, analysis, and reporting can easily allow researchers to obtain statistically significant results even without any real effects. Growing concerns culminated in the attempted replication of 100 empirical studies published in high-ranking journals by the Open Science Collaboration (2015); only 36% of replicated studies produced statistically significant results, compared to 97% of the original studies, and the mean effect sizes were approximately half that of the original studies. This finding has led to questions as to how many other published findings may be spurious – even in well-respected journals. Critically, however, replications and null findings are rarely published (Ferguson & Heene, 2012; Simmons et al., 2011). Ferguson and Heene (2012) propose that without acknowledgment of failed replications, theory cannot be falsified, resulting in 'undead' theories based on little fact. This is illustrated by the fact that, following Bem's controversial 2011 study, three independent research teams failed to replicate the findings, yet they struggled to have these results published (Yong, 2012). This

phenomenon can be seen across all sciences, however it is considerably more prevalent in psychology journals (Fanelli, 2010; Sterling et al., 1995; Yong, 2012).

These controversies have led to a 'crisis of confidence' in the field of psychology (Miller, 2022). This crisis of confidence has exposed the need for greater methodological rigour. The credibility of research in psychology is threatened by unhelpful norms and structural problems such as publication biases and competition in academia, flexibility in methodology, HARKing (hypothesizing after the results are known; Kerr, 1998), and presenting post hoc findings as a priori (Grand et al., 2018; Kepes & McDaniel, 2013). Publications are the currency in which psychology researchers trade, meaning there are clear incentives for researchers to 'chase the significant' via questionable research practices (QRPs) in order to be published (Ferguson & Heene, 2012). In response to this crisis of confidence, we find ourselves today in the midst of what has been described as a 'credibility revolution' (Vazire, 2018). Proponents of the credibility revolution in psychology advocate for greater transparency and openness, including increased preregistration of research, open access to data, procedures, materials, and analysis scripts, and call for more direct replication studies (Vazire, 2018). Vazire et al. (2022) emphasise that while the credibility revolution is rooted in improving replicability, replicability alone is not enough: attention must be paid to validity more broadly. Metascientists (those who study science itself using scientific methods and models) are actively working to identify improvements to standard research practices (Miller, 2022). For example, it has been suggested that for less permissive standards, statistical significance should be redefined and our alpha level adjusted to .005 (Benjamin et al., 2018). Similarly, Simons et al. (2017) proposed that authors should justify any generalisations they claim in a "constraints on generality" statement which makes any foreseeable limits to the generality of their findings explicit. Through intensive methods of

data collection, analysis, and reporting, researchers would be better positioned to calibrate conclusions to the quality and quantity of evidence.

The crisis of confidence extends to applied psychological sub-disciplines, including the area of industrial and organisational (IO) psychology (Kepes & McDaniel, 2013). This area of psychology is characterised by the application of the scientific method and an understanding of human behaviour to the context of organised work (American Psychological Association [APA], 2022). IO psychologists subscribe to the scientist-practitioner model, designing, executing, and interpreting research and applying findings to address human and organisational problems (APA, 2022). The primary goal of IO psychologists has been put forward as being to improve the human condition at work (Gasser et al., 2004). IO psychologists are therefore trusted with designing and implementing effective interventions predicated upon credible research. As is the case with other areas of psychology, QRPs and misconduct have been identified in the IO literature (Banks, O'Boyle Jr, et al., 2016; Banks, Rogelberg, et al., 2016; Bedeian et al., 2010). With rapidly growing membership in the IO field, checks and balances are required to ensure the credibility of this science is not threatened (Grand et al., 2018). QRPs have harmful implications for the development of theory, for perceived scientific rigour, and for evidence-based practice (Banks, Rogelberg, et al., 2016). Left unchecked, QRPs risk leading to a published IO literature which is unreliable: where theories and hypotheses are invariably confirmed, where measures are always validated, and where every intervention is effective (Banks & O'Boyle, 2013). This eventuality would unquestionably undermine the efficacy and validity of IO psychology as a field.

Grand et al. (2018) emphasise that the ability to make a meaningful contribution to employees, organisations, and societies as a whole through sophisticated research practices is an opportunity inherent to IO psychology. However, research practices employed by IO

researchers have been increasingly critiqued in recent years, as have the validity and trustworthiness of IO research (e.g. Banks & O'Boyle, 2013; Banks, Rogelberg, et al., 2016; Bosco et al., 2016; Efendic & Van Zyl, 2019). Kepes and McDaniel (2013) note that the majority of hypotheses in IO journals are supported, suggesting that "we are either approaching omniscience or our journals are publishing an unrepresentative sample of completed research" (p.252), with the latter explanation clearly being proposed by the authors as the more likely of the two. In the adjacent field of management, one survey of management faculties found that 50% of respondents knew of a colleague who had "withheld data that contradicted their previous research" (Bedeian et al., 2010, p. 719). Additionally, 60% were aware of colleagues who had "dropped observations or data points from analyses based on a gut feeling that they were inaccurate" (p.719), and almost 80% knew of colleagues who had withheld methodological information or selectively reported data which supported hypotheses (Bedeian et al., 2010). Furthermore, McDaniel et al. (2017) found that sample sizes, covariates and hypotheses in IO student dissertations differed from those reported in 63% of the published articles based on those dissertations (as cited in Efendic & Van Zyl, 2019). Importantly, while only 31.8% of dissertations reported statistically significant hypotheses, 64% of published articles were statistically significant. Clearly, the IO field is not immune to the questionable research practices identified in other areas of psychology. The scientist-practitioner model which defines IO psychology requires that science inform practice and vice versa (Grand et al., 2018). It is therefore crucial that the evidentiary base informing IO practice to solve organisational problems is well-calibrated to the quantity and quality of that evidence.

Authors play a crucial role in bottom-up change in the pursuit of 'robust science'. Robust science has been defined as Relevant, Rigorous, Replicated, Accumulative and

cumulative[1], Transparent and open, and Theory oriented (Grand et al., 2018). For science to be cumulative, that which has typically been unstated and unjustified must be made explicit and verifiable (Simons et al., 2017). Grand et al. (2018) hold authors responsible for transparently reporting all activities conducted during research and embracing publication practices which align with robust science. Thus, it falls to the authors of IO articles to transparently acknowledge the extent to which their approach to research allows for particular conclusions to be drawn (Grand et al., 2018).

**Causal Inference**

Correlation does not imply causation: this maxim is emphasised throughout undergraduate psychology lectures and laboratories alike, justifiably warning budding researchers against drawing unwarranted causal conclusions based on observational evidence. Instead of encouraging due diligence, however, it seems to have resulted in the widespread avoidance of explicit causal inference in observational research (Grosz et al., 2020). Causal inference is the process through which a conclusion is drawn that one variable influences another, based on data. Temporal direction is an essential condition for causality, in that the cause must occur prior to the effect (Höfler, 2005). As the 18th century philosopher David Hume wrote, "We may define a cause to be an object followed by another ... where, if the first object had not been, the second never had existed" (as cited in Höfler, 2005, p.3).

For causality to be determined, we need to have ruled out alternative explanations. Randomised experiments are widely considered to be the gold standard for estimating causal effects (Rohrer, 2018). They allow us to establish temporal direction and manipulate our independent variables while controlling for confounding variables and approximating counterfactuals through control groups, allowing researchers to identify causal relationships.

[1] Accumulative and cumulative science is that in which credible scientific understanding is pursued in a way which balances novel idea generation (cumulative) with fostering incremental progress through careful vetting and calibration (accumulative) (Grand et al., 2018).

Causative verbs such as ‘increase’ or ‘improve’ convey causal relationships in which one variable is put forward as influencing another (Adams et al., 2017), as do conjunctions such as ‘due to’ and ‘because’ (Solstad & Bott, 2017).

Cause-and-effect relationships define our very understanding of the world (Kant, 1781/2002, as cited in Grosz et al., 2020). While causal inference is often seen as the central aim of research, experiments are not always an option due to feasibility, possibility, or ethical limitations, and thus large areas of psychology research are observational (Grosz et al., 2020; Hernán, 2018). We may, therefore, expect observational researchers to focus on predictive or descriptive research questions. Psychology researchers do generally avoid explicit causal inference in observational research (Alvarez-Vargas et al., 2020), however their discussions may inherently depend upon a causal interpretation (Rohrer et al., 2021). Many substantive questions in psychology concern causal effects, and many researchers still implicitly ask causal research questions and draw conclusions that depend upon causal inference using observational data (Grosz et al., 2020). This can lead to careless conclusions, derived from intuition and unarticulated assumptions (Rohrer et al., 2021). Rothman (1986, as cited in Hernán, 2018) articulated the issue with this over 30 years ago: “Some scientists are reluctant to speak so blatantly about cause and effect, but in statements of hypothesis and in describing study objectives such boldness serves to keep the real goal firmly in focus and is therefore highly preferable to insipid statements about ‘association’ instead of ‘causation.’” (p.77). Similarly, Grosz et al. (2020) interpret the implicit, opaque causal inference identified in observational research as evidence of the existence of a taboo against explicit causal inference, the result of which is mixed messages and obscured research goals.

Transparency is undeniably instrumental in the pursuit of credible, cumulative science (Grand et al., 2018). Numerous studies conducted in different ways are needed to test all the assumptions and alternative causal explanations for a given conclusion; cumulative science

requires that studies are transparent about their assumptions and causal links (Grosz et al., 2020). A lack of clarity can see motte-and-bailey strategies arise, where researchers make exciting but hard-to-defend causal interpretations of their findings (the bailey), then retreat to the irrefutable yet often unimportant descriptive findings (the motte) (Grosz et al., 2020). For example, it is not uncommon for an observational study to be published where causal language is avoided throughout the hypotheses, methods, and results section, yet the research question or analyses selected are causal in nature or the implications and recommendations given in the discussion section necessitate a causal interpretation. If another researcher were to critique this study's approach or conclusion, the original researcher can 'retreat' to the position that their findings were descriptive – even if this is an almost trivial reading of the study. As Grosz et al. (2020) wrote: '"The study did not correctly answer the question it did not explicitly try to answer" is not a compelling criticism' (p. 1247). These motte-and-bailey strategies impede cumulative research. Additionally, a lack of clarity compromises the falsifiability of a theory. Falsifiability is a key tenet of contemporary scientific research (Dienes, 2008). The empirical character of science depends upon maximising falsifiability; the more fine-grained a specified causal effect is, the greater the falsifiability of a theory (Popper, as cited in (Dienes, 2008). Furthermore, without making underlying assumptions about variables and causal mechanisms explicit, the overstatement of findings during subsequent interpretation is more likely, and errors made in the research process are difficult to pick up on (Grosz et al., 2020; Hernán, 2018).

Observational research findings are often consistent with a number of potential theories (Brick & Bailey, 2020), which, in turn, would have different implications for decision-makers (Alvarez-Vargas et al., 2020). Consumers of research may be unaware that action recommendations rely on unstated assumptions, with potentially important consequences for how research is implemented. Foster (2010) provides a powerful example

of the risks associated with the norm of avoiding causal thinking in his analysis of causal inference in observational developmental psychology research, an area of research which, much like IO psychology research, often requires an observational approach despite an interest in causal mechanisms:

> For example, knowing that children in single-mother households have worse outcomes than other children is a useful association. However, that association is routinely interpreted as causal—that were the mother to marry, the child's outcomes would be improved. Such a conclusion depends on a causal relationship, and the support for such a causal relationship is fairly weak (Foster & Kalil, 2007). Laypersons, researchers, and policymakers find it difficult to distinguish these two notions. As a result, single-parent mothers can be stigmatized, and the belief that their decisions about marriage and fertility have caused their troubles leads to government inaction. Bad causal inference can indeed do real harm. (p.1456)

In other words, even if authors are able to appropriately interpret associations as distinct from causal relationships, consumers of research, including other researchers, lay persons, and policymakers, often cannot (Foster, 2010).

Articles published in quality academic journals have significant knowledge implications; language which implicitly conveys causal links risks overstating the evidence-base (Thapa et al., 2020). As an example, Haber et al. (2018) investigated causal inference in health research as consumed via social media. They reviewed the strength of causal language used in 64 published articles and the media articles which referenced them, finding that 34% of the published articles used causal language which was overstated compared to the evaluated strength of causal inference of the study, and beyond this, 48% of media articles were found to use overly strong causal language compared to the language used in the original publication, which itself was already overstated. Clearly, there is a disparity between

results and how they are communicated, and this disparity is exacerbated when these findings are then presented to the public.

The norm of avoiding causal language in observational studies can facilitate a disconnect between a study's findings and how they are interpreted when researchers attempt to tackle causal questions implicitly, despite using descriptive or predictive language and research questions (Grosz et al., 2020). This disconnect has important ramifications for policymakers and decision-makers when designing interventions (Grosz et al., 2020; Haber et al., 2018). While predictive research plays an important role in identifying target groups for example, policymakers and decision-makers cannot (and should not) use these findings to recommend or implement evidence-based interventions (Grosz et al., 2020).

Causal inference based on observational data is not a straightforward endeavour, but it is not impossible. While randomised experiments are the gold standard for ruling other alternate explanations for an observed relationship between variables, they are not always feasible or possible (Rohrer, 2018). When this is the case, as is common in psychology research, other study designs can be useful in ruling out alternative explanations. Statistical control, quasi-experiments, longitudinal studies, regression discontinuity designs, and instrumental variables are all examples of methods which can support causal inference. Regardless of the study design employed, observational researchers must be transparent about their goals of causal inference, when that is in fact a goal, and about the associated assumptions underlying research decisions (Grosz et al., 2020). This echoes Hernán's (2018) argument that research quality can be improved by explicitly acknowledging any causal objectives. Through coherent causal inference frameworks, assumptions and implications underlying causal interpretations can be made explicit and precise, improving research practices in both observational and experimental research (Rohrer et al., 2021). For example, Rohrer (2018) explores how directed acyclic graphs (DAGs) can provide a principled

approach to causal inference in observational research, using directed arrows to visually represent the causal assumptions underlying causal inferences.

Frameworks such as this provide a useful tool, however background knowledge about a given domain is essential if causation is to be inferred from correlation (Rohrer, 2018). For example, one must clarify which third variables can be ignored and which need to be controlled for, and whether statistical control would aid or hinder causal inference. To answer these questions, assumptions about the causal web which underlies key variables must be made clear (Rohrer, 2018). This is not too distinct from the assumptions required in experimental research, as causal inference still relies upon assumptions and extends beyond what is observed in a study (Grosz et al., 2020; Hernán, 2018). While we may feel more confident about estimations from data gathered in randomised control trials (RCT) due to eliminating systematic confounding and the possibility of the dependant variable causing the independent variable, ultimately these estimations are still associations. Both observational and experimental studies rely on inferences, but opaque research goals in observational studies can result in careless causal reasoning (Grosz et al., 2020). As Rohrer (2018) explains, “the critical point is thus not whether a research design hinges on additional assumptions, but which assumptions need to be made” (p. 28). Allowing for explicit causal reasoning in observational research in carefully considered, appropriately designed studies would ensure observational studies with implicit causal objectives are held to the same rigorous standards of evidence as those with explicit causal objectives.

The problem here is the norm, not the researchers; this is not a criticism of authors of observational research themselves. The norm of avoiding causal language is widespread in observational psychology, from undergraduate study through to publication review (Grosz et al., 2020; Hernán, 2018). Current incentive systems in the academic world ensure an intense pressure to publish, sowing the seeds for dysfunction in the way research findings are

reported (Grand et al., 2018). In order to meet reviewer and publisher expectations, authors often must avoid causal inference in observational studies (Grosz et al., 2020). Equally, however, authors need to argue that their findings offer a significant contribution to their field in order to be important enough to be published (Haber et al., 2018). Hence, avoiding causal language does not stop researchers from implicitly addressing causal research questions and drawing causal links, it merely drives causal assumptions underground (Hernán, 2018).

Haber et al. (2022) conducted a systematic evaluation of the use of causal and associational language in observational health research. Specifically, they estimated the extent to which causality was implied by the language used to link exposures and outcomes ('linking language') and by action recommendations, and they evaluated how aligned the language and recommendations were. Haber et al.'s team of 48 reviewers examined 1,170 articles across 18 high-profile medical journals; each article was examined by 2 independent reviewers and an arbitrating reviewer. The reviewers were guided by a review tool and framework to facilitate replicable, well-guided evaluations. All articles had their abstracts reviewed, and a third had their full text reviewed.

Haber et al. found that although few studies explicitly stated having an interest in estimating causality, many used linking language which implied causality. The linking language used in the abstracts examined had a strong causal implication in 18.7% of the articles, a moderate causal implication in 33.2%, a weak causal implication in 34.2%, and no causal implication in 13.8% of the articles. The most commonly identified linking word was "associate", used 45.7% of the time. Additionally, they found that the majority of action recommendations given implied inferred causality. Action recommendations implied a greater level of causality compared to the linking sentence in 44.5% of the articles, while 40.3% had the same level of implied causality. Their results also revealed that discussions of causal mechanisms were common, as was adjustment for confounding, suggesting an implicit

interest in causality despite the fact that numerous studies explicitly cautioned against making causal inferences. Haber et al.'s research demonstrates that avoiding causal language does not in itself ensure clarity of interpretation in this literature, and calls for greater transparency about causal interests and reasoning.

In the following section, we introduce psychological capital, an increasingly popular construct in the psychology and management literature which is often explored through observational research. We use this construct to examine whether the norm of avoiding causal language and issues with subsequent implications identified in Haber et al.'s (2022) study extends to the domain of industrial-organisational (IO) psychology. While psychological capital is only a small area of interest within the wider IO psychology field, this rapidly growing area of research provides a topical vehicle through which we may highlight the importance of considering the use of causal inference in IO psychology more broadly.

## Psychological Capital

The present study investigates the use of causal inference in the field of psychological capital. First proposed by Luthans et al. in 2004, psychological capital consists of the combined psychological resources of hope, self-efficacy, resilience, and optimism, often referred to as HERO. In conceptualising psychological capital, Luthans et al. (2004a) drew on the positive psychology movement emerging at the time, which focuses on actualising human potential and building strengths and wellness, as opposed to the focus on dysfunction and illness which traditionally characterises psychology.

## Facets of Psychological Capital

The four psychological resources that make up psychological capital are self-efficacy, hope, optimism, and resilience (HERO). Hope is defined as a motivational state derived from a combination of a sense of agency, pathways, and goals (Snyder, 1995). A sense of agency

motivates individuals towards their goals by providing the necessary determination and willpower. In addition to agency, hope requires a sense that one is capable of developing alternative pathways to reach goals even when obstacles block the current pathway (Snyder, 1995). Research suggests that leaders' hope is associated with the financial performance of business units and employee job satisfaction and retention (Peterson & Luthans, 2003). Luthans and Youssef (2004) explain that hope can be developed through techniques such as setting clearly specified, measurable, realistic yet challenging goals, as well as through delegation and empowerment to provide employees with feelings of greater agency. These techniques support one's ability to foster agency and generate pathways to achieve their goals (Snyder, 1995).

Self-efficacy (or confidence) has been defined as a personal judgement of one's ability to deploy the cognitive resources, motivation, and action required to successfully complete a task or course of action within a given context (Bandura, 1982). It has been found to be related to reduced turnover intentions, and increased organisational commitment and perceived organisational effectiveness cross-culturally (Luthans & Youssef, 2004). In their meta-analysis of 114 studies, Stajkovic and Luthans (1998) found that self-efficacy as a component of psychological capital had a strong positive relationship with job performance, with a correlation of .38. This would suggest that self-efficacy has a stronger relationship with performance than many prominent personality traits (e.g., conscientiousness), attitudes (e.g., job satisfaction), and performance initiatives (e.g., goal setting). Considerable research demonstrates that self-efficacy can be developed (Lupșa et al., 2020), particularly through experiencing feelings of mastery via tools such as coaching, on-the-job training, and experiential exercises (Heslin & Klehe, 2006). Other approaches include verbal persuasion, where individuals receive credible praise and encouragement, and modelling, which is

achieved by observing a relevant mentor or role-model, or even through imagining oneself performing successfully (Heslin & Klehe, 2006).

Resilience is the capacity to recover quickly from difficulties such as uncertainty, adversity, failure, or overwhelming changes (Luthans, 2002). Research indicates that resilient individuals are able to continue functioning at or near their normal level after traumatic events, and that they may, over time, not only recover from setbacks, but bounce back to improved performance and a greater sense of meaning in their lives, further cementing their resilient outlooks (Bonanno, 2005; Jayawickreme & Blackie, 2014; Luthans et al., 2004). In their recent meta-analysis, Lupșa et al. (2020) found that interventions that aimed to enhance resilience had the largest effect size of all of the psychological capital components, which suggests it may be the most malleable. Masten and Reed (2002) recommend three kinds of strategies for developing resilience in children and youth, which have been applied to an organisational context: risk-focused, which aim to prevent or reduce stressors in the first place; asset-focussed, which aim to enhance resources for achieving positive outcomes; and process-focussed, which mobilise adaptational systems using strategic planning and learning to enhance an organisation's preparedness for crises and ability to adapt using their resources (Luthans et al., 2004).

Drawing from attribution theory, optimism is a positive explanatory style, where negative events are interpreted as temporary, external, and specific to the situation while positive events are seen as permanent and pervasive (Forgeard & Seligman, 2012). Seligman and Schulman (1986) found that a positive explanatory style positively predicted job performance and the retention of life insurance sales agents. Optimism can be developed through approaches such as practising gratitude (Harty et al., 2016), and the 'best possible self' manipulation, where one imagines a future in which everything has unfolded in the most ideal way possible (Meevissen et al., 2011).

The four dimensions of psychological capital (HERO) have been put forward as operating synergistically. Youssef-Morgan and Luthans (2013) assert that together, these resources can be recruited to overcome challenges and achieve goals, which, in turn, can result in compounding success and positivity. Observational studies have seen psychological capital associated with numerous outcomes, including wellbeing (Gautam et al., 2019), life satisfaction and flourishing (Santisi et al., 2020), job satisfaction (Luthans et al., 2007), and innovative work behaviour (Chen et al., 2021).

The number of psychological capital articles published per year has increased steeply since 2016[2]. The growing interest in the topic is unsurprising given the increasing focus on employee wellbeing both pre- and post-pandemic (e.g. Guest, 2017; Joly, 2020; Nielsen et al., 2017), with organisations often eager to equip their employees with personal resources to optimise their psychological wellbeing and performance in the workplace (Schaufeli & Taris, 2014). Luthans et al. (2004) suggest that the management of psychological capital may be an effective, ethical approach to channelling employees' strengths and psychological capacities, contributing to a sustainable competitive advantage for the organisation. Psychological capital interventions provide a potential avenue for achieving these goals, with the aim of synergistically developing each element of HERO (Youssef-Morgan & Petersen, 2019). With the typical psychological capital intervention lasting two to three hours, the brevity and ability to tailor these sessions is likely to make them particularly attractive workplace interventions (Youssef-Morgan & Petersen, 2019).

[2]In a search of articles that have been published on Scopus since 2000 with "psychological capital" in the article title in the subject areas of Business, Management and Accounting, Psychology, or Social Science, the number of publications can be seen to have increased sharply since 2016. See Figure 1 in Methods for a graphical representation of this trend.

Luthans et al. (2004) have proposed that psychological capital sits alongside the other forms of intangible capital possessed by a business: intangible human (or 'intellectual') capital, and social capital. These other forms of capital have long been recognised as critical to successful organisational performance, providing a source of competitive advantage (Harter et al., 2002; Luthans et al., 2004). Luthans et al. (2004) suggested that psychological capital moves beyond these traditional forms of capital during a time where capital investment was critical in light of the lean-and-mean operating approaches which were being employed to meet the economic challenges of 2004, such as outsourcing and restructuring. With the ongoing COVID-19 pandemic presenting similar challenges to organisations today, psychological capital research may be seen as more relevant than ever.

**Developing Psychological Capital**

Claims of malleability and openness to development are a key characteristic of psychological capital (Luthans & Youssef-Morgan, 2017). Luthans et al. (2004a) submit that the psychological capacities which make up psychological capital (HERO) are more flexible than fixed traits such as personality, but more stable than moods or emotions (Luthans et al., 2007). Longitudinal studies indicate that psychological capital can vary over time (Avey et al., 2010; Peterson et al., 2011), and experimental studies suggest that changes and developments can be made through relatively short training sessions (e.g. Dello Russo & Stoykova, 2015; Luthans et al., 2014; Luthans et al., 2008). If psychological capital is indeed a state-like characteristic, changes can be measured and interventions assessed on their impact on the bottom-line to understand their effectiveness (Luthans, 2002; Luthans et al., 2004). The ability to estimate the return on investment (ROI) of psychological capital interventions likely makes it an attractive initiative in organisations.

Lupșa et al.'s (2020) meta-analysis found that psychological capital interventions have small but significant effects on performance and wellbeing. Interestingly, interventions

which focus on psychological capital as a whole were found to be less effective than those which address just one of the components of psychological capital (Lupșa et al., 2020). Additionally, it appears that interventions must be adapted based on the organisational context to have a greater than small effect (Lupșa et al., 2020). Self-efficacy, optimism, and resilience were found to be most susceptible to development via interventions, although the small sample sizes for hope and psychological capital as a composite higher-order factor limited the robustness of the results (Lupșa et al., 2020). Lupșa at al. (2020) also noted that a knowledge gap exists as to how to best design and implement complex interventions aimed at the psychological capital construct as a whole.

It is worth noting that investment in initiatives which are aimed at increasing personal resources places the burden of improving workplace wellbeing on the employee, 'fixing' the employees rather than taking a systems-based approach which addresses the structural factors threatening employee wellbeing. Nevertheless, the ROI on the development of psychological capital has been estimated to be high: in fact, a ROI of well over 200% was claimed following a 2.5 hour psychological capital intervention session, based on an estimate of psychological capital scores increasing by 2% and being sustained over one year (Luthans et al., 2015). These utility calculations depend upon many assumptions, and highlight the extent of the claims surrounding psychological capital as a resource for organisations. Psychological capital development has been clearly positioned as an attractive focus for investment by organisations, where a positive ROI is paramount.

It has become apparent that the benefits of some popular constructs in the positive psychology field are overstated (e.g. Gardner et al., 2023). Mindfulness, for example, has received extensive interest as an intervention to support employee wellbeing, despite uncertainty as to how sustained the improvements are and research which suggests potential adverse effects for some (Gardner et al., 2023). Few psychological processes are invariably

beneficial (Britton, 2019); research suggests that meditation, a mindfulness-related intervention, can be fruitless or even harmful for certain individuals (Farias et al., 2020). Kreplin et al.'s (2018) meta-analysis on the effects of meditation on prosociality found that, of the 22 studies assessed, 61% showed weak methodological quality, with problems such as experimenter, expectations, and confirmation biases. Artificial intelligence (AI) systems have similarly seen a rapid increase in popularity in all aspects of business, despite the lack of independent research into their effectiveness in supporting decision-making (Centranum, 2021). Key risks with these systems for predicting job performance include inherited bias, lack of validity, and inability to adapt to changes in the organisation's context (Centranum, 2021).

These brief examples highlight how theories which become popular can be misapplied and their effectiveness can be subject to exaggeration. While psychological capital interventions are typically investigated using experimental studies, many of the associations identified between psychological capital and other variables are based on observational studies. As discussed previously, observational research may be subject to implicit causal reasoning. As the popularity of psychological capital continues to rise, it is critical that the causal reasoning within this literature is transparent.

**The Present Study**

This study is a small-scale conceptual replication of Haber et al.'s (2022) study which evaluated how causal and associational language is used in observational health research. Conceptual replications are where an existing study's fundamental idea is tested using different methods (Crandall & Sherman, 2016). Here, we apply Haber et al.'s focus to an entirely different domain of research: psychological capital.

Psychological capital has been positioned for real-world application in organisations. The effectiveness of decision-making in this space is largely predicated on the capacity to

draw causal inferences from the research. Psychological capital is often investigated through observational research; with knowledge of the complexities and pitfalls associated with causal reasoning in observational articles, it would be wise to evaluate language use and implied causality in the extant research. As interest in psychological capital continues to grow, we have an opportunity to address issues with implied causal inference if any such issues are identified.

This study focuses on the linking language used in the psychological capital literature. Linking language is the words and phrases which describe the nature of the relationship between a given exposure and outcome. Identifying the linking language commonly used in this research and the strength of causality implied by this language will help us understand whether the norm of avoiding causal language identified in other areas of observational research extends to the psychological capital literature. The causal implication of action recommendations is also examined; where a given action recommendation relies upon causal inference, this recommendation may be invalid if the study is not appropriately designed to accommodate such reasoning. In addition, we explore the alignment of causal implication strength between the linking language used in linking sentences and subsequent action recommendations. If there is no significant correlation between the strength of causality of linking language and strength of causal implications in recommendations, this would suggest that a disconnect exists between the language used to describe a given relationship and the subsequent recommendations for action.

Also of interest is whether authors explicitly caution against drawing causal inferences based on their findings, and, if so, whether they use linking language or provide action recommendations which imply that causality has been inferred. Additionally, we identify whether authors transparently acknowledge an intent to draw a causal inference. If causal inference is rarely acknowledged or even cautioned against, yet present in the

research, this would suggest that authors are reluctant to engage in explicit causal reasoning, or perhaps are unaware of the pitfalls of such inference. We also examine whether authors make use of strategies which could potentially be used to increase the credibility of causal inference.

Specifically, in line with Haber et al.'s (2022) primary research questions, we aimed to:

(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, and
(4) examine the prevalence of misalignments between causal implications of linking language and subsequent action implications.

In addition to these questions, this study presents some secondary research aims:

(5) examine whether studies contain a transparent acknowledgement of an intent to draw causal inferences,
(6) examine whether studies contain explicit causal disclaimer statements, and whether causal links are implied anyway, and
(7) 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.

While the present study's approach was strongly influenced by Haber et al.'s (2022) study of causal language in observational health research, some key differences exist due to

the smaller scale of this study and the different domain of interest. These differences are detailed in Appendix A.

## Methods

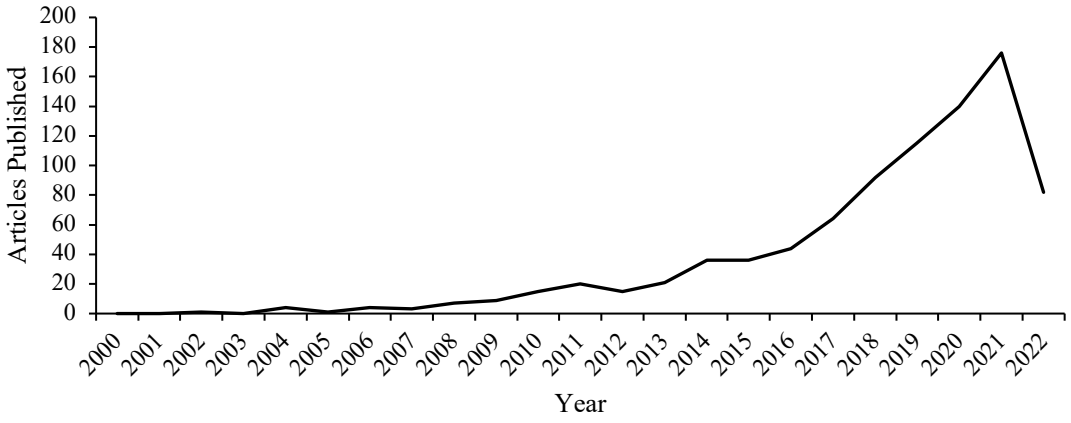
This study's methods were pre-registered. Preregistration allows for a research plan to be specified in a registry prior to a study being conducted, in order to improve the credibility of results and promote transparency and quality of research practices (Centre for Open Science, n.d.). Prior to the finalisation of the preregistration, search results in Scopus were reviewed and some articles read in order to understand what the inclusion criteria should specify to ensure a sufficiently broad range of psychological capital studies were selected.

### Phase 1: Initial Article Selection

A search was performed on Scopus for articles featuring the key words "psychological capital" in the article title to filter out articles in which the construct was not a variable of interest. The search was limited to the subject areas of Business, Management and Accounting, Psychology and Social Science because they had the most psychological capital publications on Scopus and are most relevant to the field of industrial-organisational psychology. The search was then limited to articles published after 2016 as this was when the number of articles relating to psychological capital published in these areas per year on Scopus increased sharply (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 2000 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**

A sample size of 50 (plus an additional 2 for training) was selected for a margin of error of 15% in estimates of proportions at the 95% confidence level. The margin of error for proportions was used as the basis for sample size determination because of the descriptive focus of this study, as several of the main analyses are centred on reporting for proportions. This was calculated using a power analysis in G*Power. This sample size also reflected the capacity of the single reviewer in this study. To be included in the analysis, a paper had to include a research question concerned with the relationship between psychological capital and one or more other variables, in which psychological capital was a predictor variable, outcome variable or mediator. Studies which were only concerned with psychological capital as a moderator were excluded. Studies were included only if the research questions were examined quantitatively using primary data, with an observational research design. This included longitudinal studies. However, quasi-experimental studies were excluded due to their non-observational nature.

Articles titles and abstracts were screened in the order in which they appeared in the Scopus search results. Accept/reject decisions were made for each until 52 articles had been accepted. The first two articles accepted served as training articles, where the data extraction protocol was trialled as specified in the following subsection, Phase 3: Data Extraction.

Of the 50 articles reviewed in this study, 42 used cross-sectional designs, while the remaining 8 employed longitudinal approaches.

The selected articles were screened for predatory publishers using Beall's List (last updated in 2021; Beall, 2021) after the data analysis phase of this study. A small number of articles were published in Frontiers, which has been the subject of claims of misconduct in the publication process (Beall, 2021) although some controversy around this is noted (e.g. Bloudoff-Indelicato, 2015). One article was published by Allied Academies, which is affiliated with the predatory OMICS Publishing Group (Yadav, 2018). Because these were not unambiguously predatory publishers themselves, they were not removed from this dataset.

**Phase 3: Data Extraction**

An adapted version of Haber et al.'s (2022) review tool was employed. Initially, the review tool was applied to the two training articles. The reviewer and primary supervisor independently reviewed the training articles using the initial version of the review tool, then met to discuss the intent and application of each review question. As a result of this discussion, minor changes were made to the review tool after pre-registration and prior to data extraction. The initial version of the review tool is attached to this study's preregistration. The final version of the review tool can be found in Appendix B. Both can be found online at https://osf.io/w3hd8/?view_only=54150c2ed96b417896b3d7a3e8b1fbe5. Changes made from the pre-registered version are detailed in Appendix C.

During data extraction for the present study, a small number of ambiguous responses were sent to the primary supervisor of this study for a second opinion. The changes made to the data post-extraction as a consequence of this second opinion are detailed in Appendix D.

Two articles were determined to not fit the inclusion criteria after data extraction had begun. These were replaced by the next two articles from Scopus following the same process through which the original 52 were gathered.

### *Data to be Extracted by Review*

The following protocol was modelled on Haber et al.'s (2022) pre-registered data extraction protocol, adapted to suit the requirements of this study. The order that the articles were reviewed in was determined using a random sequence generator (https://www.random.org/). The data was extracted from the title, abstract, and the discussion/conclusion sections of each article, as well as a scan of the full text for mention of key words of interest (e.g., "confound" and "causal") using the 'Command+F' search function. Aside from this, the introduction, methods, and results sections were not read.

**Independent and Outcome Variables.** The independent and outcome variables of each article were identified.

**Linking Sentences.** The sentence which contained the most prominent linking phrase(s) between independent and outcome variables in both the abstract and the discussion was identified. This sentence had to include psychological capital as one of the variables of interest. For the review of the discussion sections, the order of preference for locating relevant sentences was the first paragraph in the discussion, followed by the second paragraph, and so on. Where multiple sentences met these requirements, the one that made the strongest causal claim was selected. Haber et al. (2022) selected the sentence which occurred first, however for the present study it was decided that selecting the sentence which maximally implied causation would provide greater insight.

**Linking Words.** Next, the key linking word or phrase in reference to psychological capital was identified. One was selected per abstract and discussion as the main linking phrase in the linking sentence. Modifiers of the identified linking word or phrase were also identified for potential further exploratory analysis of how language affects causal interpretations, however this was not explored and is noted here for transparency. Modifying words are those that alter the nature of the linking relationship, including any phrases that demonstrate strength, weakness, or doubt about the robustness of the linking phrase, for example "We find that X is *strongly* associated with Y".

Prior to analysis, the root of each linking word was manually identified. Examples of how each root word was determined can be seen in Table 1.

**Table 1**

*Examples of Root Word Determination*

| Primary Linking Sentence | Linking Word | Root Word |
|---|---|---|
| "The results indicated that PsyCap was positively correlated with occupational well-being and work engagement." (Guo et al., 2022, p. 1) | Correlated | Correlate |
| "Our results indicate a positive relationship between PsyCap and career success." (Kauffeld & Spurk, 2022, p. 285) | Relationship | Relate |

**Causal Implication of Linking Words.** The degree to which the linking words/phrases implied causality within the context of their linking sentences was then assessed on an ordinal categorical scale (e.g., no implication, weak implication, some implication, strong

implication). This rating scale is shown in Table 2, along with definitions and examples of a sentence rated at each level. Examples given have been taken directly from the data gathered in this study.

Where the selected linking sentence referred to mediation, if the linking language *other* than the reference to mediation had no causal implication, this was rated as 'weak' to account for the inherent causality of a mediation relationship (Ghosh & Jacobson, 2016), whilst still relying upon what the authors conveyed aside from their use of mediation.

**Table 2**

*Linking Language Causal Implication Strength Rating Scale: Definitions and Examples*

| Strength | Definition | Example |
|---|---|---|
| None | The linking sentence does not imply in any way a causal relationship was identified | "The results demonstrated that PsyCap and PSC were both positively associated with ASB and PSB at the individual level" (Siami et al., 2022, p. 379) |
| Weak | The linking sentence might imply a causal relationship was identified, but it is unclear or possible to come to that conclusion in the absence of any causal inference | "The results suggest the mediating effect of frontline service employees' innovative behavior in psychological capital and customer VCC behavior relationship" (Farrukh & Ansari, 2021, p. 2561) |
| Moderate | The linking sentence mostly implies a causal relationship was identified, but it is unclear or possible to come to that | "The study's findings support H1, as the direct effect of PsyCap on IWB is significant." (Kumar et al., 2022, p. 5) |

| | | |
|---|---|---|
| | conclusion in the absence of any causal inference | |
| Strong | The linking sentence clearly implies that causality had been identified. | "The results show that both salespersons' self-monitoring and psychological capital enhance sales performance via adaptive selling." (Wang et al., 2021, p. 1918) |

*Note.* Definitions from Haber et al., 2022.

**Action Recommendations.** Action recommendations were identified for both the abstract and discussion sections of each article. These were sentence(s) containing recommendations or implications based on how the results and conclusions of the research might be used, for example, "Therefore X may be an important strategy to improve…". If there were multiple action recommendations, the implication with the strongest causal implication was chosen. Where this did not distinguish the recommendation, that which occurred first was selected.

**Causal Implication of Action Recommendations.** A subjective assessment was made of whether the action recommendations (i.e., what should be done with the results of the analysis) implied, required, or were predicated on the assumption that a causal inference had been made. This was largely based on whether the article suggested changing the amount of the predictor variable in order to modify or keep the amount of the outcome the same, for example, "Organisations should invest in training to enhance this important psychological resource for improved performance" requires causality to have been inferred, as it suggests modification of a psychological resource to achieve an outcome: improved performance. The degree to which the action's implications imply causality was assessed on an ordinal categorical scale. (e.g., no implication, weak implication, some implication, strong implication). The rating scale is defined in Table 3, along with examples of an action

recommendation rated at each level. Examples given have been taken directly from the data gathered in this study.

**Table 3**

*Action Recommendations Causal Implication Strength Rating Scale: Definitions and Examples*

| Strength | Definition | Example |
|---|---|---|
| None | The action recommendation would be made appropriately in the absence of any causal relationship | No examples |
| Weak | The action recommendation may be made appropriately had a causal relationship been identified, but it is unclear or possible to come to that recommendation in the absence of any causal inference. | "First, the results offer pragmatic implications on sales force selection. Though self-monitoring is important, managers should also take other personality traits such as PsyCap and Big Five personalities into consideration." (Wang et al., 2021, p. 1930) |
| Moderate | The action recommendation most likely could only be made appropriately had a causal relationship been identified, but there is a small possibility that one could come to that recommendation the absence of any causal inference | "First, our research verifies that psychological capital can trigger a series of positive behaviors, having positive impact on knowledge sharing and IWB. Therefore, we recommend that organizations should pay attention to the psychological capital and mental health of employees." (Chen et al., 2021, p. 9) |

| | | |
|---|---|---|
| Strong | The action recommendation could only be made appropriately had a causal relationship been identified. | "Therefore, the main lesson learned through this study was that any investment in PsyCap training programs could represent a winning and "sustainable" HR strategy, aimed at improving the potential of individuals and teams and at increasing the competitive advantage of the organizations, which is a high-order priority, especially in the current unstable and complex times." (Giancaspro et al., 2022, p. 13) |

*Note.* Definitions from Haber et al., 2022. 'Moderate' adapted for clarity.

**Additional Information.** The review tool identified whether Structural Equation Models or graphical causal models were used, whether variables were controlled or adjusted for, and whether confounding factors were discussed. It also examined whether a causal disclaimer statement was made (for example, "the observational nature of this study means that causal inferences cannot be drawn"), and whether there was any explicit acknowledgement of an intent to draw causal inference.

**Analysis**

The statistical analyses for this study were largely descriptive. The first stage of analysis involved determining what linking words are used to described relationships between predictors and outcomes in the psychological capital literature. This was done using a count and calculating proportions with a 95% confidence interval (CI) of the number of times each linking word was identified.

Next, estimates of the degree to which linking words state or imply causality in the psychological capital literature were generated using the proportion of linking words rated at each level of causal implication.

Similarly, in order to examine the prevalence of action recommendations that would require causal inference to have been made, the proportion of action recommendations rated at each level of causal implication was calculated.

The alignment between the language used to describe relationships and implications subsequently drawn was then examined. First, the distribution of linking word causal strength and causal action implications was plotted. Then, the proportion of articles where the rated causal strength of the action recommendation was commensurate to and stronger than the rated causal strength of the linking sentence was generated. Finally, a two-tailed Spearman's rho rank test at a 5% alpha level was conducted to examine the relationship between the strength of causal linking sentences and action recommendations.

Finally, proportions were used to examine the prevalence of transparent acknowledgment of causal intent, causal disclaimer statements, and models which could be used to support causal inference.

Where no action recommendations were given, this was recorded as 'N/A' and the causal strength rating was 'N/A' for missing. Listwise exclusion was applied for analyses. There was no other missing data.

All analyses were performed within R, version 4.2.1 (R Foundation for Statistical Computing, Vienna, Austria).

As this study only included data collected from public documents, it was determined to be outside the scope of Massey University's ethics code, and therefore no ethics application or low risk notification was completed.

### Data Code and Availability

The data and code for this study can be found through the Open Science Framework (OSF) repository at https://osf.io/w3hd8/?view_only=54150c2ed96b417896b3d7a3e8b1fbe5.

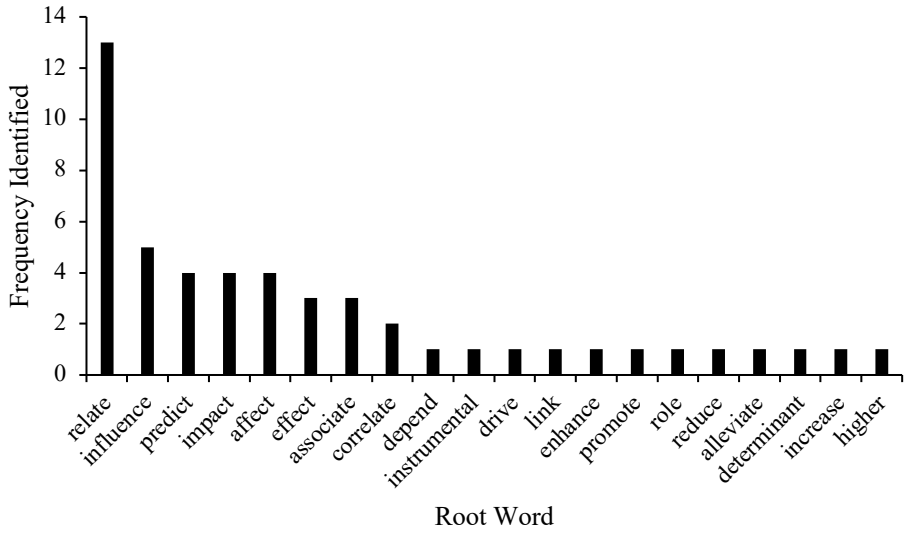
## Results

### Linking Words

The root word most commonly used to link predictor and outcome in the primary linking sentence of the abstracts was "relate" (*n* = 13/50, 26%, 95% CI [16, 39]). The next most common root word was "influence" (*n* = 5/50, 10%, 95% CI [0, 23]), followed by "predict", "impact", and "affect" (all *n* = 4/50, 8%, 95% CI [0, 21]). Figure 2 shows the frequency of root words identified in the primary linking sentences of the abstracts in the articles assessed.

**Figure 2**

*Frequency of Root Words in Abstracts*

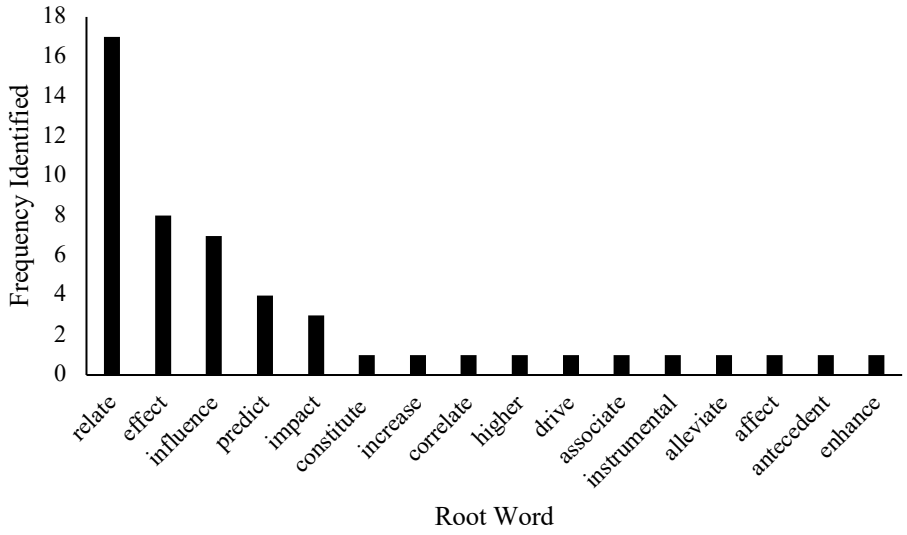



In the discussion sections, "relate" was again the most common linking root word identified within each article's primary linking sentence (*n* = 17/50, 34%, 95% CI [22, 48], followed by "effect" (*n* = 8/50, 16%, 95% CI [4, 30]) and then "influence" (*n* = 7/50, 14%,

95% CI [2, 28]). Figure 3 shows the frequency of the root words identified in the primary linking sentences of discussion sections.

**Figure 3**

*Frequency of Root Words in Discussion*



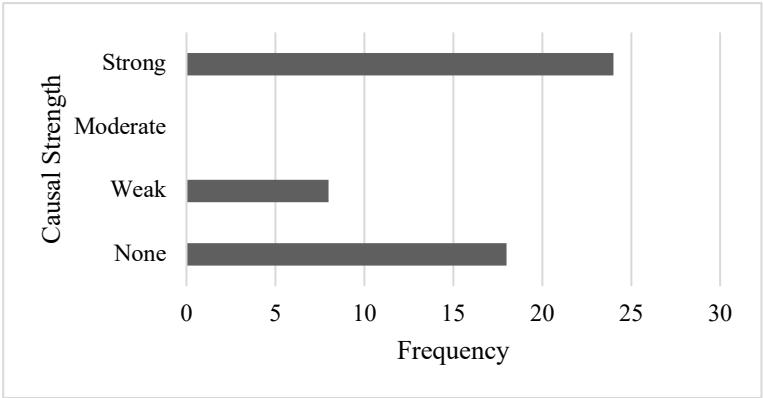

## Strength of Causal Implication

### *Linking Sentences*

The primary linking sentence of the abstracts was rated as having no causal implication in 36% (*n* = 18/50, 95% CI [24, 52]) of the articles, a weak causal implication in 16% (*n* = 8/50, 95% CI [4, 32]) of the articles, and a strong implication in 48% (*n* = 24/50, 95% CI [36, 64]) of the articles. No abstract linking sentence was rated as having a moderate causal implication. Figure 4 shows the frequency at which the primary linking sentences of the abstracts were rated at each level of strength of causal implication.

**Figure 4**

*Strength of Causal Implication in Abstract Linking Sentence*




Looking at the root words most commonly identified in the primary linking sentence of the abstracts, “relate” was found to have no causal implication in the context of the linking sentence in 62% (95% CI [38, 85]) of the articles. For example, “The results indicate a significant positive relationship between PsyCap, workplace wellbeing, and employee engagement with task performance” (Al Kahtani & Sulphey, 2022, p. 1).

‘Relate’ had a weak causal implication in 38% (95% CI [15, 62]) of the articles, for example, “The results support the hypothesis that positive affect serves as a mediator in the relationships between PsyCap and OCBO” (Da et al., 2021, p. 1). This is an example of where, as noted within the methods section of this article, the linking sentence refers to mediation but language *other* than the reference to mediation has no causal implication, and so this was rated as ‘weak’ to account for the inherent causality of a mediation relationship, whilst still relying upon what the authors conveyed aside from their use of mediation.

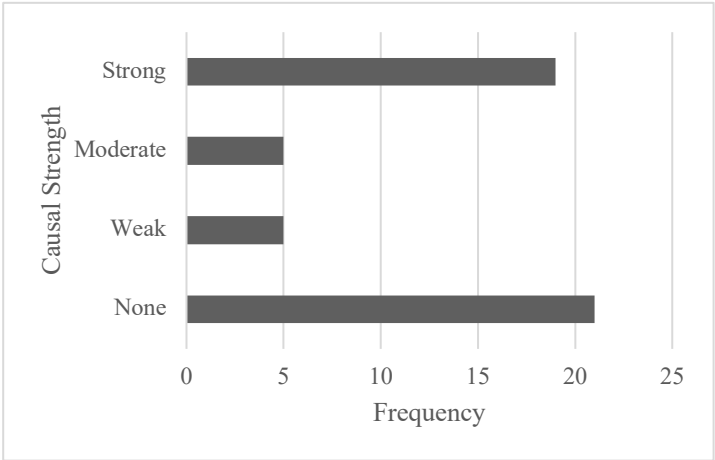
“Influence” had a weak causal implication within the context of the linking sentence in 20% (95% CI [0, 51]) of the articles (e.g., “We found that team PsyCap strength had a significant influence in the prediction of most outcomes”; Dawkins et al., 2021, p. 397) and a strong causal implication in 80% (95% CI [60, 100]) (e.g., “Our results support the notion that organizational psychological capital positively influences creative innovation of SMEs and thus performance during crises”; Grözinger et al., 2022, p. 689).

"Predict" was found to have no causal implication in the context of any of the linking sentences it was identified in (e.g., "Psychological capital can predict career commitment significantly and positively."; Hu et al., 2021, p. 1). In contrast, "impact" and "affect" were found to have strong causal implications within the context of every primary linking sentence they were identified in (e.g., "The results confirmed that psychological capital has a significant positive impact on adaptive performance"; Luo et al., 2021, p. 1).

The linking sentences identified in the discussion section were rated as having no causal implication in 42% (*n* = 21/50, 95% CI [30, 58]) of articles assessed, a weak causal implication in 10% (*n* = 5/50, 95% CI [0, 26]) , a moderate causal implication 10% (*n* = 5/50, 95% CI [0, 26]), and a strong causal implication in 38% (*n* = 19/50, 95% CI [26, 54]). Figure 5 shows the frequency at which the primary linking sentences of the discussion sections were rated at each level of strength of causal implication.

**Figure 5**

*Strength of Causal Implications in Linking Sentences in Article Discussion Sections*




In terms of the root words most commonly identified in the primary linking sentences of the discussion, "relate" was found to have no causal implication in the context of the linking sentence in 82% (95% CI [71, 100]) of the articles, for example "In line Hypothesis H1a and H1c, our results revealed a positive relationship between PsyCap and career satisfaction and career coping" (Zyberaj et al., 2022, p. 11).

"Relate" had a weak causal implication in 18% (95% CI [6, 37]) of the articles (e.g., "Firstly, the research proved that PsyCap is related to happiness and that thriving partially mediated the relationship"; Basinska & Rozkwitalska, 2022, p. 557).

The linking word "effect" was found to have moderate causal implications in the context of the linking sentence in 38% (95% CI [13, 71]) of the articles, for example, "We found that PsyCap of Chinese special education teachers had a significantly positive direct effect on occupational well-being, which corroborates previous evidence that PsyCap helps promote workers' performance and well-being" (Guo et al., 2022, p. 5). This was rated as moderate due to the use of "direct effect", which is statistical terminology, and thus the possibility exists that authors were just noting the statistical output as opposed to claiming a causal effect. "Effect" had strong causal implications in 63% of the articles (95% CI [38, 96]) (e.g., "The results support the research hypothesis that psychological capital has a positive effect on employees' adaptive performance"; Luo et al., 2021, p. 13).

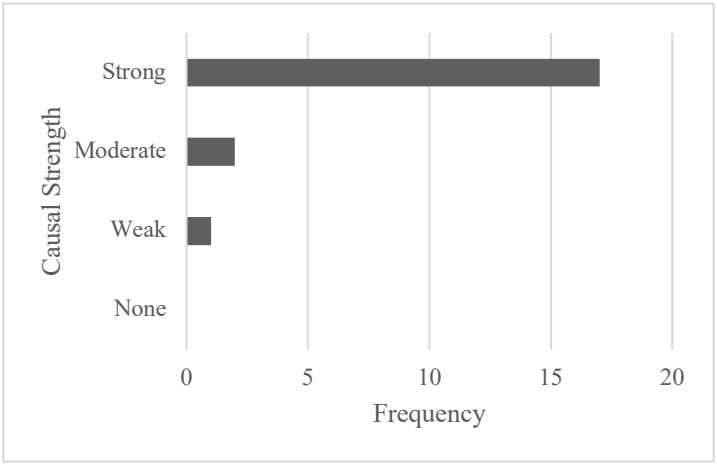
"Influence" was found to have a weak causal implication in 14% (95% CI [0, 54]) of articles (e.g., "We also investigated how individual and team PsyCap strength influenced the prediction of these outcomes, with analyses revealing that team PsyCap strength had a significant influence in the prediction of most outcomes"; Dawkins et al., 2021, p. 410), and 14% (95% CI [0, 54]) were rated as having moderate causal implications (e.g., "The influence from PC on ECS explained 49.4% of the variance of success"; Al Issa, 2021, p. 537). "Influence" was rated as having a strong causal implication in the context of the linking sentence 71% (95% CI [57, 100]) of the time (e.g., "The findings demonstrated that PsyCap and PJ fit significantly and negatively influenced WFC and FWC, which was consistent with the COR theory"; Yan et al., 2022, p. 9).

### *Action Recommendations*

Forty percent (95% CI [28, 55]) of the articles included an action recommendation in their abstract. Of the action recommendations identified, 85% (95% CI [75, 100]) were rated as having a strong causal implication, for example, “These results have important implications for practice, and they emphasize that specific interventions aimed at promoting human service professionals’ PC may positively impact the effectiveness of their actions for the adaptation and psychosocial development of their clients” (Di Maggio et al., 2021, p. 639). Ten percent (95% CI [0, 26]) had a moderate causal implication (e.g., “As a result, it is suggested that hotels need to understand the psychological state of their members and manage their responses and attitudes”; Lee et al., 2022, p. 1), and 5% (95% CI [0, 21]) had a weak causal implication (e.g., “These findings provide several implications for managers to take the advantages of psychological capital in their recruiting, training, and career development programs for employees”;  Nguyen & Ngo, 2021, p. 89). None of the action recommendations identified were rated as having no causal implication whatsoever. Figure 6 shows the frequency of implied causality in the action recommendations in the abstracts.

**Figure 6**

*Strength of Causal Implication in Abstract Action Recommendation*

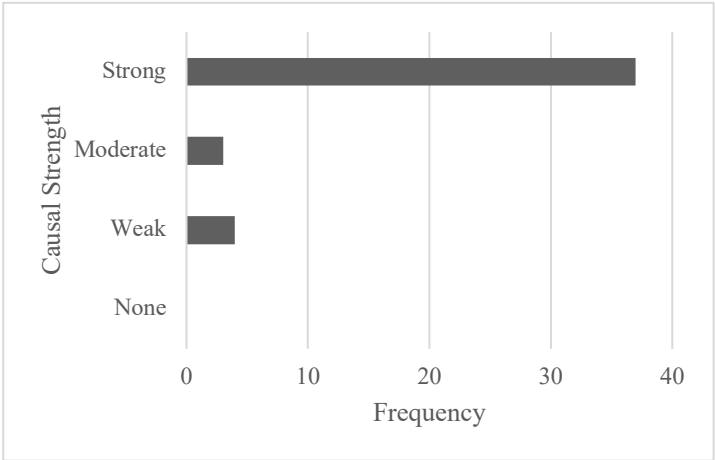



Of the 88% (95% CI [82, 98]) of the articles that included an action recommendation in their discussion/conclusion section, 84% (95% CI [75, 94]) were rated as having a strong

causal implication, for example, “Thus developing PsyCap through inventions would help enhance wellbeing and task performance, which could, in turn, facilitate organizational effectiveness” (Al Kahtani & Sulphey, 2022, p. 13). Seven percent (95% CI [0, 16]) were rated as moderate (e.g., “…the results from the present study suggest that these institutions should not ignore the importance of psychological capital and EI in bringing sustained competitive advantage”; Usman et al., 2022, p. 17), and 9% (95% CI [0, 19]) were rated as weak (e.g., “Similarly, service organizations can develop other indicators of a psychologically positive work environment such as PsyCap which is a valuable resource that service organizations can advance among their employees”; Siami et al., 2022, p. 393). Again, none of the action recommendations identified were rated as having no causal implication whatsoever. Figure 7 shows the frequency at which the action recommendations identified within the discussion sections were rated each strength of causal implication.

**Figure 7**

*Strength of Causal Implication in Discussion/conclusion Action Recommendations*



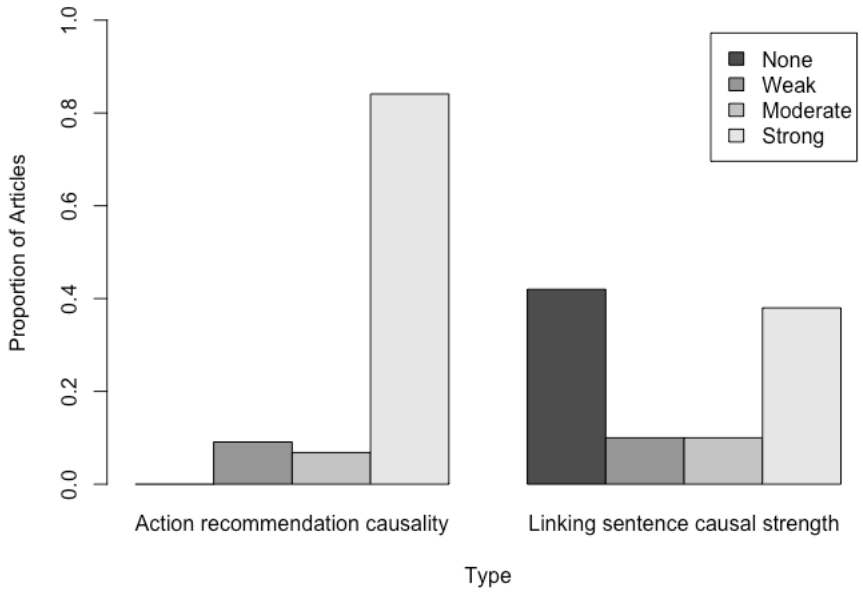

### *Comparing Causality of Linking Language and Action Implications*

A two-tailed Spearman’s rank correlation rho at a 5% alpha level was conducted to estimate the relationship between the strength of causal implication of the linking language and the strength of causality implied in the action recommendation within a given article’s discussion section. No significant relationship was found ($r_s$ = .20, $p$ = .19, 95% CI [-.10,

.47]) between linking sentences' strength of causal implication and action recommendations' strength of causal implication[3]. The strength of the causality implied in the action recommendations corresponded to the strength of the causality implied in the linking sentences in 43% (95% CI [30, 58]) of the articles. Causality implied in the action recommendations was stronger than causality implied in the linking sentences in 55% (95% CI [41, 70]). Figure 8 highlights the difference in the distributions of the strength of implied causality for linking sentences within the discussions' primary linking sentences and the strength of implied causality in the primary action recommendations in the articles examined.

**Figure 8**

*Distribution of Linking Sentence and Action Recommendation Causal Strength*




## Causal Intent

Only 10% (95% CI [4, 18]) of the articles transparently acknowledged an intent by the authors to draw causal inferences from their data. This included statements such as "In

[3]Here we use the term 'linking *sentence*' rather than the 'linking *word*', which is used in the preregistered analysis plan, for clarity. We conducted analyses using linking words to allow us to aggregate the root word of each linking word for analysis, however the linking words' causal implications were determined entirely by the rating of their respective linking sentences.

the present study, we attempt to examine the causal relationship between knowledge sharing and interpersonal trust in enhancing psychological capital of faculty members" (Usman et al., 2022, p. 4) and "To test the causal relationship among psychological capital, social capital and frontline hotel employees' adaptive performance and reduce the potential for standard method variance, data were collected twice at a two-week interval" (Luo et al., 2021, p. 13).

At times it was difficult to identify whether articles included acknowledgements of causal intent. For example, Yan et al.'s (2021) first mention of an intent to examine causality was in their theoretical implications, where they reported that "A sample of 228 respondents from eight five-star hotels employed…was utilized to examine the causal relationships between PsyCap, OC, JS and turnover." (p.10). Similarly, Gupta et al. (2022) do not mention causation until their limitations section, stating that "Although we used a sound theoretical framework… the data used was cross-sectional, which might not strongly support the causal relationship suggested in our study." (para. 46).

Of the remaining 90% (95% CI [84, 98]) articles which did not explicitly acknowledge the authors' intentions to examine causation, 76% (95% CI [64, 87]) made action recommendations which strongly depended upon a causal relationship having been identified, for example, "The study results suggest that firms could enhance their employees' innovation outputs by developing and nurturing their PsyCap and job crafting skills" (Tho, 2022, p. 348).

This study also looked for other indications of authors' potential interest in causation, including the use of strategies which can increase the credibility of causal inferences. Models which could be used to support causal inference were used in 88% (95% CI [82, 98]) of the articles examined: flowcharts with directed arrows, which imply a temporal order among variables and therefore some level of causality, were used in 74% of the articles, and half of the articles used Structural Equation Modelling (SEM). Additionally, variables were

controlled in 62% (95% CI [50, 76]) of the articles, and confounding was discussed in 10% (95% CI [4, 18]) of the articles. Mediation analysis was used in 84% (95% CI [76, 94]) of articles. It should be noted that the models and strategies examined in the present study were selected as specific examples, and do not represent all possible approaches nor their effectiveness. Additionally, whether or not these *were* used in a way which would support causal inference was not examined, rather, the existence of strategies which *could* be used in this way was identified.

Forty-two percent (95% CI [30, 57]) of the articles contained an explicit causal disclaimer statement. Causal disclaimers statements were defined as any statement in the discussion which explicitly mentioned the need for caution or provided a disclaimer about inferences of causality. Examples include: “The data used in the study are mainly cross-sectional data, which cannot inform the causal relationship between variables” (Peng et al., 2022, p. 12), “Finally, our data do not allow conclusions about causality but provide preliminary support for the hypothesized relationship” (Prasath & Bhat, 2022, p. 82), and “First, the research design was cross-sectional and causal inference cannot be made” (Zhou & Zheng, 2022, p. 6).

Of the articles which did contain an explicit causal disclaimer statement, 62% implied some degree of causality through linking language in the abstract (33% strong, 95% CI [14, 58]; 29% weak, 95% CI [10, 53]) and 43% in their discussion sections (14% strong, 95% CI [0, 34]; .14% moderate, 95% CI [0, 34]; 14% weak, 95% CI [0, 34]). Fifty-seven percent of articles which contained an explicit causal disclaimer statement made action recommendations which could only be made appropriately had a causal relationship been identified (71% strong, 95% CI [53, 92]; 6% moderate, 95% CI [0, 27]; 24% weak, 95% CI [6, 44]).

## Discussion

The present study examined the causal nature and implications of language used to link variables within the psychological capital literature. Through this small-scale systematic evaluation of observational psychological capital studies, it was found that:

1. The linking word most commonly used to describe the relationship between predictors and outcomes was “relate”, followed by “influence”, “impact”, and “effect”.
2. The majority of primary linking sentences implied some level of causality, despite the fact that very few articles explicitly stated an intent to estimate causal effects and many explicitly warned against drawing causal inferences.
3. The majority of action recommendations had strong causal implications.
4. No significant relationship was found between the causality implied in the linking sentences and the strength of causal implication of the action recommendations.
5. The causal implications of the action recommendations were often stronger than the causal implications of the linking language.
6. Most articles used some form of causal model, some formal and some informal, and strategies which could increase the credibility of causal inferences were identified.

Overall, a clear misalignment was identified between the causal implications of the linking language used when reporting results and that of the subsequent action recommendations.

These findings echo those of Haber et al. (2022), who found that most studies within their review used linking language that had moderate or strong causal implications, and that the vast majority of action recommendations implied causation, despite the fact that few articles explicitly stated an interest in causal effects. They also found a disconnect between

the causal implications of linking language and action recommendations, as the causal implications of action recommendations tended to be stronger. Additionally, Haber et al. found that many studies included disclaimers about causation, cautioning readers against inferring causality while implying an interest in causality in their discussions. The present conceptual replication of Haber et al.'s 2022 study confirms that these findings apply to a completely different domain: psychological capital.

Interestingly, unlike Haber et al. (2022), we did not see many traditionally non-causal linking words taking on more causal meanings. While "relate" was the most common linking word within the primary linking sentences, most of the time it was not used in a way which implied causality, and in almost all instances where it was rated as having a causal implication this was in reference to a mediated relationship. In contrast, Haber et al. saw a greater spread across the causal implication ratings for words such as "relate" and "predict". Instead, traditionally causal linking words, including "influence", "impact", and "effect", were among the most commonly identified in the present study. These words convey causal relationships through positioning one variable as influencing another (Adams et al., 2017). The use of such linking words may be a reflection of authors attempting to write in exciting, varied ways, as suggested by Thapa et al. (2020), as opposed to representing an intent to convey causal relationships. Alternatively, it could signal inadequate training in research design and appropriate causal inference. Alvarez-Vargas et al. (2020) found that psychology faculty, postdocs, and doctoral students perceived studies which use causally ambiguous statistical language as of higher quality and providing similar or greater support of policy recommendations than studies with straightforward causal language. Targeted training around the use of causal language in observational research would ensure researchers are equipped to calibrate their conclusions to the quality and quantity of evidence (Alvarez-Vargas et al., 2020).

Taken together, these findings suggest that the taboo against causal language in observational studies highlighted by Grosz et al. (2020) may not apply to the same extent within the psychological capital literature. Rather, causal language was used by a substantial number of articles examined in this study, but it was used *inappropriately*, explicitly conveying the existence of causal relationships without having made this intention clear, or at times despite having warned against such an interpretation. This can overstate the evidence and has important implications for how research is implemented, and given the field of study, may have negative consequences for those that are the subject of such implementation.

While psychology researchers typically avoid explicit causal inference in observational studies (Alvarez-Vargas et al., 2020), many substantive research questions concern causal effects and thus discussions often hinge upon a causal interpretation (Rohrer et al., 2021). It may therefore be unsurprising that some level of causality was implied in the linking statements of more than half of the abstracts and discussion sections that were examined, despite the observational nature of these studies. In the present sample, action recommendations were most commonly rated as having strong causal implications, in that they could only be made appropriately had a causal relationship been identified. In fact, none of the action recommendations identified were rated as having no causal implication whatsoever. Action recommendations which would be made appropriately in the absence of causal inference, for example, include recommendations for targeting purposes or documenting disparities. Additionally, the action recommendations had stronger causal implications than the linking sentences in over half of the articles examined. This may be a reflection of authors attempting to provide impactful, interesting recommendations. Not making causal inferences underlying such recommendations explicit, however, risks leading to conclusions which are based on unarticulated assumptions and intuition (Rohrer et al., 2021). In fact, no significant relationship was found between the causal implication of the

action recommendations and the causality implied in the linking sentences. This lack of alignment could lead to decision-makers and practitioners unwittingly acting on recommendations despite the lack of an appropriate evidence base.

These findings suggest that the psychological capital literature is not immune to the motte-and-bailey strategies Grosz et al. (2020) warn of. The authors of the articles that were reviewed in this study were often found to give action recommendations which were exciting and impactful for organisations and employees, but which depended upon causal interpretations of their results (the bailey). However, the descriptive nature of the results could also provide a retreat (the motte) if challenged (Grosz et al., 2020). For example, many articles recommended implementing psychological capital training for employees, implying that this would lead to improvements in a variable of interest but without evidence of this causal effect. Interventions such as training are costly in terms both time and money and place the onus of improving workplaces on employees, so recommendations for action need to be well-calibrated with the evidence they are based on.

Without carefully designed causal frameworks, explicit assumptions, and methods to test causal inference (which can be critiqued by research consumers who can then decide whether or not they agree with the conclusions), a correlational study cannot determine whether, for example, psychological capital increases performance, if higher performance leads to higher psychological capital, or if some third variable affects both performance and psychological capital. Each of these potential relationships has different implications for decision-makers. Where recommendations imply that the temporal direction of a relationship has been established and that one variable is effecting change in another, there is an implication that this is based on evidence of causation. It is easy to see the risk this poses. Where inappropriate implications and recommendations are made, applications and interventions may be ineffectual or even harmful. This is costly for organisations and risks

undermining the credibility of researchers who promote, and practitioners who apply, the research findings. If all intentions, research decisions and assumptions about establishing causation were transparently communicated, consumers and decision-makers would be better positioned to evaluate recommendations and make informed decisions.

Most articles in the present study used some form of formal or informal causal model. The formal models identified were Structural Equation Models (SEM), while the informal models were flowcharts with directed arrows, which reflect an inherently causal way of thinking, with an arrow beginning at one variable and leading to another. Strategies which could increase the credibility of causal inference were also identified, including the use of control variables and confounders. These methodological decisions are examples of how research decisions *can* suggest a potential interest in causality, although here we merely note their existence in this sample, not whether or not these strategies *were* used in a way which would support causal inference.

Coherent causal frameworks and strategies can improve research practices in both observational and experimental research, but improvement is dependent on being explicit and precise about the underlying assumptions (Rohrer et al., 2021). Research design, whether experimental or observational, depends upon some level of assumption and speculative inference (Rohrer, 2018). Murky research goals make careless causal reasoning harder to identify and may result in diminished methodological accountability, especially where a lack of clarity means indirect causal implications are protected from criticism (Hernán, 2018). The blanket assumption that causality can never be inferred from observational research may mean that there is lack of appropriate checks and balances in place, and that unwarranted causal claims may be overlooked. Motte-and-bailey strategies impede healthy debate and criticism within the research community. In addition, a lack of transparency risks overstating

findings, and errors in the research process become harder to identify (Grosz et al., 2020; Hernán, 2018). Where research goals are obscure, cumulative science is compromised.

Although almost half the articles in this study included a statement explicitly cautioning against drawing causal conclusions, it appears that these disclaimers may have been included due to convention. Many of these same articles implied some degree of causality in their linking sentences and gave action recommendations which could only be made appropriately had a causal relationship been identified. This suggests that the psychological capital literature is subject to what Tennant and Murray (2021) term 'Schrödinger's inference', "where the authors caution against causal interpretations while themselves offering causal interpretations" (p.e2). This reinforces that discouraging causal reasoning in observational studies is unhelpful, and indicates that the inclusion of disclaimers does not necessarily mean causal interpretations have been avoided.

Allowing for explicit causal reasoning in observational studies which are carefully considered and appropriately designed could create the conditions in which authors feel able to be transparent about their intentions without concern that their results will be considered invalid from the outset because of the observational nature of the work. It would ensure that studies with causal objectives are held to the same standards as experimental studies, ultimately improving the quality of research being produced. Although warnings against causal language in observational studies are pervasive from undergraduate study through to publication review (Grosz et al., 2020; Hernán, 2018), it is currently unclear to what degree various players in the academic system contribute to the spoken and unspoken rules surrounding the use of causal language (Haber et al., 2022). Haber et al. (2022) suggest that while journals have few rules explicitly dictating language, they may have unspoken norms or even formal internal guidelines. With respect to causal reasoning more broadly, Grosz et

al. (2020) highlight that expectations do exist among reviewers and publishers that causal inference be avoided in observational studies.

As academics face intense publication pressures, it is possible that avoiding causal language yet making action recommendations which assume a causal relationship is a reflection of conflicting incentives. In order to be published, authors are incentivised to meet reviewers' expectations that causal language be avoided in observational research, while at the same time needing to argue that their findings offer a significant contribution to the field. Ultimately, a balance will need to be struck in which authors of observational studies are not immediately dismissed for engaging in causal reasoning in their papers, and are instead evaluated on the transparency of their reporting and reasoning, as well as the quality of evidence upon which their conclusions are based, within the bounds of observational research.

**Implications**

The maxim 'correlation does not equal causation', so commonly expressed in psychology lectures and laboratories, justifiably warns against drawing causal conclusions from observational research, yet evidently does not prevent causal inference within the psychological capital literature, or even the use of causal language when reporting results. Instead, causal intentions are often murky, emerging through the linking language used to report results and action recommendations made. The issue of transparency is at the forefront of conversations as the psychological research community re-evaluates the unhelpful norms and structural problems which threaten the field's credibility (e.g. Grand et al., 2018; Grosz et al., 2020; Vazire, 2018; Vazire et al., 2022). As researchers work to identify improvements to standard research practices to combat the structural problems and norms which contribute to the credibility doubts threatening psychology research as a whole, the way causal inference is approached needs to be reconsidered. Much like HARKing and publication biases, the

transparent reporting of intentions to examine causation, research decisions, and assumptions is an important step towards more rigorous methods of data collection, analysis, and reporting, ultimately ensuring research findings and recommendations are better aligned with the research evidence**.** Authors play a vital role in bottom-up change in the pursuit of robust science (Grand et al., 2018). Thus, it falls to the authors of IO articles to ensure that they acknowledge the extent to which their research supports their conclusions. That which has previously been unstated must be made explicit and verifiable. If the research objective is to establish causation, authors must say so and must take steps to increase the credibility of any claims made.

Observational researchers with causal interests should ensure they are applying the methods and research design which best supports this, within the confines of observational methodologies. The vast majority of articles included in this study were cross-sectional, with a few employing longitudinal approaches. For research on psychological capital, experimental studies should be conducted where random assignment is feasible. For example, much of the psychological capital literature refers to training interventions to increase psychological capital. Lupșa et al.'s (2020) meta-analysis found that psychological capital interventions have small but significant effects on wellbeing and performance; these interventions could be used to answer research questions with psychological capital as the independent variable. Where experimental research designs are not possible, observational studies are required. The causal interpretation of associations identified in observational studies requires additional assumptions, however methodological tools that depend on more plausible assumptions have been developed across diverse fields (Foster, 2010).

Causal inference frameworks such as graphical causal models can be applied to support causal interpretations through intensive formalisation which requires precise questions to be asked and assumptions and their derived implications to be articulated

(Rohrer & Murayama, 2021). Causal DAGs (Directed Acyclic Graphs) are an example of graphical causal model which offer a principled approach to causal inference based on observational data (Rohrer, 2018). DAGs visually represent causal assumptions using directed arrows (i.e., single-headed) (for a detailed explanation, see Rohrer, 2018). As Rohrer (2021) highlights, while these frameworks are no panacea, they may facilitate more productive debates.

In addition to frameworks such as this, there are a variety of methodological approaches which can enhance the credibility of causal inferences. As an example, longitudinal studies can aid in causal inference in observational research (Rohrer & Murayama, 2021). Rohrer and Murayama (2021) argue that causal inference should be put "upfront when planning to collect and analyze longitudinal data" (p. 4). They highlight that while longitudinal data alone are not sufficient for causal inference, they can provide a useful tool. An example of a model which can facilitate causal inference in longitudinal studies is the dynamic panel model, which aims to identify lagged reciprocal causal effects (for further detail on how these models can support causal inference, see Rohrer & Murayama, 2021). Ultimately, the goal should be to maximise the plausibility of causal inferences through transparent reporting of the evidence base of such inferences, using the best methods available within the constraints of feasibility, informed by strong theory (Foster, 2010).

Reviewers and publishers must be cognisant of implied causality, and rather than simply monitoring whether causal language has been used, they should be questioning whether it is plausible given the evidence presented. By surfacing assumptions about causality, disconnects between research findings and their interpretation will be subject to greater checks and balances.

This study's findings are alarming for IO psychology practitioners interested in psychological capital. It is evident that the language used and implications made when

reporting findings can overstate the evidence base by implying that a causal relationship has been identified. The IO psychology community is not exempt from the crisis of confidence facing psychology today (Kepes & McDaniel, 2013). As the psychological capital construct has been oriented for application in organisations, the risks associated with recommendations for action which are poorly calibrated with the research evidence are clear.

IO psychology is a profession which defines itself by the application of the scientific method (APA, 2022), implementing research findings in order to design and execute effective interventions. If the IO literature were to be unreliable, the validity of IO psychology as a field would be undermined. IO practitioners play an important role in solving organisational problems and can have very real effects on the day-to-day experiences of employees. Thus, they have an obligation to be critical consumers of research and must be wary of unsubstantiated claims in the psychological capital literature. To do so, practitioners must recognise cases where articles make action recommendations based on causal inferences, and critically evaluate the strength of evidence for those inferences. Descriptive findings cannot be used as the basis for recommending or implementing interventions (Grosz et al., 2020). Causal questions must be explicit and supported by the appropriate strategies, assumptions, and research decisions, to allow a critical lens to be used.

**Limitations**

The time and resource constraints inherent to a Master's thesis led to some key limitations in this study, including the limited sample size and scope, and the single reviewer. The small sample size of only 50 articles is a notable limitation that reduces the statistical power and precision of this study and may mean that only a small proportion of the psychological capital literature has been represented in the sample, which could impact the external validity of these findings. This reduced precision is reflected in the broad confidence intervals generated.

Another limitation is the subjective nature of the causal implication ratings, which was heightened by only using one reviewer. With just one reviewer, it was not possible to estimate interrater reliability, and, consequently, the extent to which measurement error affects these ratings is unknown. Haber et al. (2022) identified differences in how their reviewers rated the causal implications of the linking words. They suggest that these differences may arise from the varying backgrounds of researchers as well as other factors which may influence interpretation, and that this is likely to reflect the differences in interpretation among research consumers in general (Haber et al., 2022).

The present study's scope was limited in that it did not directly evaluate the suitability of the articles' study designs or methods for supporting causal inference. Additionally, only a small section of each article was reviewed in this study. As specified in the Review Tool, data was collected by reviewing the articles' abstracts and discussion/conclusion sections. With greater resources and time, a thorough evaluation of study design and methodology would have provided greater insight into the extent that causal inference is employed and supported in these observational studies.

Additionally, the causal implication strength rating scale (see Table 2, in the Methods section) has a similarly worded definition for the Weak and Moderate ratings. As per Haber et al.'s (2022) definitions, a Weak rating is defined as 'The linking sentence might imply a causal relationship was identified, but it is unclear or possible to come to that conclusion in the absence of any causal inference', the key difference for a Moderate rating is that instead of 'might imply', it reads 'mostly implies'. The similarity between these definitions may introduce ambiguity to their interpretation and application.

This study has only addressed causal inference within the psychological capital literature, which is a small area of IO psychology research and practice, so the findings may not be generalisable to other areas. Regardless, the message remains clear: IO psychology

researchers and practitioners alike must remain wary of implicit causal reasoning in research articles.

**Recommendations for Future Research**

This study has demonstrated that some of the psychological capital literature, particularly observational studies, is subject to implied causal inference through the linking language used and recommendations for action given. It would be valuable for future research to explore other areas of IO psychology, to better understand the generalisability of these findings.

Future studies would benefit from using a larger sample size and a larger number of reviewers to account for the subjective nature of causality ratings. It would be prudent to ensure the reviewer pool was made up of individuals representative of the wide range of populations which could interact with this research (Haber et al., 2022). IO psychology practitioners should be included as part of this review pool.

In order to understand how to incentivise transparent reporting of causal inference, the underlying problem must first be diagnosed. It is likely that the intense pressure to publish leads to authors feeling the need to argue the significance of their findings, leading to motte-and-bailey strategies with murky research goals. It would be valuable to interview observational researchers to understand why they engage in such strategies, to identify possible interventions moving forward. Similarly, interviewing editors and reviewers about how they assess action recommendations and causal conclusions when reviewing observational research would provide a basis for a framework to be established to support their evaluations. Bringing a qualitative lens to this would help ensure the problem is accurately defined before resources are developed to support the evaluation of causal reasoning. For example, a framework may guide peer reviewers to check manuscripts for inconsistencies between action recommendations and statements about causality in results

sections. Authors would then be incentivised to avoid such inconsistencies so as to satisfy peer reviewers.

## Conclusion

In recent years the discipline of psychology has been criticised for questionable research practices, leading to the credibility revolution we are facing today. Proponents are advocating for changes including greater transparency and openness in the research process, as well the better calibration of conclusions with the quality and quantity of the evidence-base. Psychological capital, a rapidly growing area of IO psychology research, has been clearly positioned for real-world application in organisations. Accordingly, psychological capital training programs have become popular workplace interventions, aiming to develop psychological wellbeing and performance in the workplace. However, the relationship between psychological capital and other variables is often investigated through observational research. The present study demonstrates that unarticulated causal inference exists within psychological capital research. Recommendations for practice are regularly being made which depend upon a causal effect having been established, despite such a causal interpretation being inconsistent with the linking sentences used to describe the results or even being explicitly cautioned against. This study reinforces the dangers of not making the causal reasoning in observational studies explicit, and calls for more comprehensive training for students, researchers, and reviewers on the complexities of causal inference. Rather than driving assumptions about causation underground, causal interests and research decisions with potential causal implications should be made clear, allowing for critical consumption of research. IO professionals, and other practitioners interested in the psychological capital construct, should be wary of the recommendations made from observational research. As the IO field continues to grow, we have an opportunity to prevent the overstatement and misapplication of findings and ensure the credibility of the profession is upheld.

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## Appendix A

Differences to Haber et al.'s Protocol

### Objectives

The primary objectives of the present study were the same as Haber et al.'s (2022). Their secondary objectives were not explored in the present study. Some of their tertiary objectives were explored in the present study as secondary objectives, specifically:

- Haber et al.'s 9th objective is explored here as our 6th objective.
- Haber et al.'s 12th objective is part of our 7th objective.

The following table (Table A1) details Haber et al.'s pre-registered objectives in full, as well as the present study's objectives. Similar objectives are denoted using matched superscript letters.

**Table A1**

*Comparison of Objectives*

| Haber et al.'s objectives | The present study's objectives |
|---|---|
| Primary: | Primary: |
| 1. Identify the associational linking words and phrases used to describe relationships between exposures and outcomes examined in the high impact published health literature.[a] | 1. Identify the linking words and phrases used to describe relationships between predictors and outcomes in psychological capital literature. [a] |
| 2. Generate estimates of the degree to which linking words and phrases state or imply causality.[b] | 2. Generate estimates of the strength of causality stated or implied by the linking phrases and sentences in the psychological capital literature.[b] |
| 3. Examine the prevalence of recommendations and action claims, as | 3. Examine the prevalence of action claims, recommendations, and other implications |

well as other implications, that would require causal inference to have been made.[c]

4. Examine the prevalence of disconnections between the language used to describe relationships and implications subsequently drawn.[d]

Secondary:

5. Develop a list of what linking words could be considered to imply causality, based on a guided framework.
6. Document how the type and strength of language changes between the title, abstract, discussion, and action claim of journal articles.
7. Identify differences in the types and strength of language used across different types of studies, clinical areas, and journals.

Tertiary:

8. Examine trends in language over time.
9. Examine whether studies contain causal disclaimer statements.[e]
10. Examine language differences across journals.

that would require causal inference to have been made.[c]

4. Examine the prevalence of misalignments between causal implications of linking language and subsequent action implications.[d]

Secondary:

5. Examine whether studies contain a transparent acknowledgement of an intent to draw causal inferences.
6. Examine whether studies contain explicit causal disclaimer statements, and whether causal links are implied anyway.[e]
7. 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.[f]

11. Examine language differences across substantive medical topic areas.
12. Examine whether and how observational studies control/adjust for variables, and how that relates to language used.[f]
13. Examine and characterise modifying phrases used to describe relationships.

**Article selection**

- Haber et al. determined the 15 highest-ranking health journals and used PubMed to identify all articles published within these journals within their specified time frame (2010-2019). The present study's initial article selection approach is smaller in scale due to the time and resource constraints of Master's thesis research.

**Screening and selection**

- Haber et al. had two levels of inclusion criteria: journal and article. The present study did not use journal as an inclusion criterion.
- Haber et al. required that the article's primary research question be concerned with one primary exposure and one primary outcome. Here, this criterion was extended to one *or more* variables in *any* of the research questions and included mediators, due to the high volume of studies in the psychological capital literature which investigate multiple research questions, exposures (or, as is more commonly worded in the psychology literature, predictor variables), and/or outcomes, and the prevalence of mediators in the literature. This change did not impact the objectives of this study, as we ensured that the selected linking sentence or action recommendation included psychological capital as

either an independent variable or outcome variable, and this was factored into adjustments made to the review tool for data extraction.

- Haber et al. included a small selection of RCTs to address one of their secondary objectives. This secondary objective was not included in this study due to time and resource constraints and thus RCTs were not included.

**Data extraction**

Haber et al.'s (2022) review tool was adapted for greater applicability to the domain of psychological capital, including changes to questions and definitions for improved clarity and greater relevance to our present objectives.

- As mentioned above, their inclusion criteria was adapted to allow for studies with mediation models. As discussed in the Methods section, under Phase 3: Data Extraction, mediation inherently implies causality (Ghosh & Jacobson, 2016), although there is some argument that it is purely a statistical method (Hayes, 2013, as cited in Ghosh & Jacobson, 2016). Because mediation was used so commonly in the articles in our sample, when one sentence referenced mediators and another did not, the one which did not refer to a mediator was selected. This was in order to limit the extent to which conclusions might be driven by an assumption that reporting a mediation model implies causal inference.
- Questions relating to pop-outs were removed, as these are uncommon in this literature, as well as questions on causal theory explanations, as this was not relevant to the present study's objectives. Fewer options for the kind of formal causal model were included, based on what is commonly seen in research in this domain, and the response options for controlling variables were changed to 'yes/no' to suit our objectives. We also added a

question on whether there was any acknowledgement of intent to draw causal inference to address our additional secondary objective (objective 5).

- Haber et al. reviewed all the articles' abstracts, but only one-third had the full text reviewed. In the present study, all articles were reviewed in full (i.e., abstract and discussion). This was decided after pre-registration once data extraction had begun, as many abstracts lacked action recommendations which would have severely limited the volume of data.
- When identifying linking sentences, Haber et al. selected the sentence which occurred first, however for the present study it was decided that selecting the sentence which maximally implied causation would provide greater insight.

**Analysis**

- The action recommendation analyses in the present study were performed on the data gathered from the discussion section, rather than the abstract. This was because few articles in the psychological capital literature included action recommendations within their abstracts.
- We did not separately rate the causality of the root words and the linking sentences; instead, the rating given to the respective linking sentence was used for root word analyses. This was due to the small-scale nature of this study, with one reviewer and only 50 articles.
- A Spearman's rho rank test was used here instead of ordinal logistic regression due to the simplicity of the analysis. With only one predictor variable and one outcome variable, it was decided that a simple Spearman's rho rank test would be sufficient.

**Appendix B**

Review Tool

# PsyCap Review Tool

* Required

## Article Information

1. Article Title *

2. Article Identifier *

## 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.

## Definitions

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.

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, consequence, result, and so on.

Linking words/phrases
A word or phrase that describes the nature of the connection between some de ned predictor and some de ned 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 include: "associated with", "effect", "increased", "link", "correlated with", "impact", "benefit/harm", "predictors", "risk factor",
"protective factor", "Influence of", "determinant/determining factor", "exacerbated (or attenuated)", "modified the risk" etc

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. This includes phrases like "may be," "positively," "strongly", "potentially", "is likely to…" etc.

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). 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 action 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. For this project, calls for additional research are not considered to be action recommendations.

3. Independent variable(s) of interest *

A few word description, copied directly from the title and/or abstract. Gather from the title if available, and if not, the introduction section, discussion section, or results section of the abstract (in that order).

4. Outcome variable(s) of interest *

A few word description, copied directly from the title and/or abstract. Gather from the title if available, and if not, the introduction section, discussion section, or results section of the abstract (in that order).

Abstract

Abstract: Linking sentence section

5. Abstract: Primary Linking Sentence(s) *

What is the primary sentence/phase used that contains the linking phrases between the independent variable and outcome variable? The selected sentence must include psychological capital as either an independent variable or outcome variable. Ignore any linking sentences which do not meet this requirement. Search in particular for a sentence that contains the independent variable, outcome, linking word, and any modifying phrases. Copy and paste from the abstract. If there are multiple sentences that equally meet these guidelines, choose the sentence with the strongest causal language.

6. Abstract: Primary Linking Word/Phrase *

Based on the sentence copied above, select the primary linking word/phrase and copy it here. The word or phrase should be up to three words maximum, often including a preposition. It should not contain any modifying phrases. If there are multiple words/phrases, choose that which maximally implies causality.

7. Abstract: Modifying word/phrases

Based on the sentence copied above, copy any modifiers here. This means any words or phrases which modify the nature (e.g. strength, intensity, room for doubt, negotiation, direction etc) of the primary linking word/phrase. If not, leave this blank. If there are multiple, separate with a semicolon.

8. Abstract: How strongly does the language in this sentence imply that the authors identified a causal relationship between the independent variable of interest and the outcome of interest?

*Mark only one oval.*

- None: The linking sentence does not imply in any way a causal relationship was identified
- Weak: The linking sentence might imply a causal relationship was identified, but it is unclear or possible to come to that conclusion in the absence of any causal inference
- Moderate: The linking sentence mostly implies a causal relationship was identified, but it is unclear or possible to come to that conclusion in the absence of any causal inference
- Strong: The linking sentence clearly implies that causality had been identified

Abstract: Action Recommendation(s) Section

9. Abstract: Action Recommendation(s)

Copy (if any) what major claims are made about how a consumer of this research might utilise its results and conclusions. The selected claim must be in reference to psychological capital. Ignore any claims which do not meet this requirement. If there are multiple, choose the one which maximally implies causal inference in the question. Note: Actions calling for more research do not apply here. If none, leave blank.

10. Abstract: Action recommendation causal implication *

Choosing the claim which most implies or requires that the evidence from this study was causal in nature, how strongly is this implication made?

*Mark only one oval.*

- ◯ N/A: No action recommendation(s) provided in this abstract
- ◯ None: The action recommendation would be made appropriately in the absence of any causal relationship
- ◯ Weak: The action recommendation may be made appropriately had a causal relationship been identified, but it is unclear or possible to come to that recommendation in the absence of any causal inference
- ◯ Moderate: The action recommendation most likely could only be made appropriately had a causal relationship been identified, but there is a small possibility that one could come to that recommendation in the absence of any causal inference
- ◯ Strong: The action recommendation could only be made appropriately had a causal relationship been identified

Full text: Introduction/methods

11. Introduction/methods: Formal causal model *

Is any formal causal model presented anywhere in this paper? This might include a graphical causal model, equations, simulations etc. While this question is in the Introductions/methods section of this review tool, any formal causal model found anywhere in the article should be included here. Check all that apply.

*Check all that apply.*

- [ ] Causal Directed Acyclic Graph (DAG)
- [ ] Other graphical causal model (describe in "other")
- [ ] Structural equations model
- [ ] No, there are no formal causal models presented in this paper
- [ ] Other: _____

12. Introduction/methods: Are there variables controlled, adjusted, matched or stratified on? *

This should be for the "main" specification only (i.e. the result most prominently displayed in the abstract) *Mark only one oval.*

- ◯ No
- ◯ Yes

Full text: Discussion/conclusions

Discussion/conclusions: Linking Sentence Section

13. Discussion/conclusions: Primary Linking Sentence(s) *

What is the primary sentence/phase used that contains the linking phrases between the independent variable and outcome variable? The selected sentence must include psychological capital as either an independent variable or outcome variable. Ignore any linking sentences which do not meet this requirement. Copy and paste from the discussion or conclusions section. Preference for this sentence is the first paragraph of the discussion or conclusions section. If there are multiple sentences that equally meet these guidelines, choose the sentence with the strongest causal language. If none, look at the second paragraph, and so on until linking sentence is identified.

Search in particular for a sentence that contains the exposure, outcome, linking word, and any modifying phrases.

14. Discussion/conclusions: Primary Linking Sentence(s) *

*Mark only one oval.*

- First paragraph of the discussion or conclusions section
- Second paragraph of the discussion or conclusions section
- Third paragraph of the discussion or conclusions section
- Elsewhere in the discussion or conclusions section
- Other:

15. Discussion/conclusions: Primary Linking Word/Phrase *

Based on the sentence copied above, select the primary linking word/phrase and copy it here. The word or phrase should be up to three words maximum, often including a preposition. It should not contain any modifying phrases. If there are multiple words/phrases, choose that which maximally implies causality.

16. Discussion/conclusions: Modifying Word/Phrase

Based on the sentence copied above, select any modifying words/phrases which modify the nature (e.g. strength, intensity, room for doubt, negation, direction, etc) and copy it here. If not, leave this blank. If multiple, separate with a semicolon.

17. Discussion/conclusions: How strongly does the language in this sentence imply that the authors identified a causal relationship between the primary independent variable and the primary outcome? *

*Mark only one oval.*

- None: The linking sentence does not imply in any way a causal relationship was identified
- Weak: The linking sentence might imply a causal relationship was identified, but it is unclear or possible to come to that conclusion in the absence of any causal inference
- Moderate: The linking sentence mostly implies a causal relationship was identified, but it is unclear or possible to come to that conclusion in the absence of any causal inference
- Strong: The linking sentence clearly implies that causality had been identified

Discussion/conclusions: Action recommendation(s) section

18. Discussion/conclusions: Action Recommendation(s) *

Copy (if any) what major claims are made about how a consumer of this research might utilise its results and conclusions. The selected claim must be in reference to psychological capital. Ignore any claims which do not meet this requirement. If there are multiple, choose the one which maximally implies causal inference in the question. Note: Actions calling for more research do not apply here. If none, leave blank.

19. Discussion/conclusion: Action recommendation causal implication *

Choosing the claim which most implies of requires that the evidence from this study was causal in nature, how strongly is this implication made?

*Mark only one oval.*

- ◯ N/A: No action recommendation(s) provided in the discussion/conclusion
- ◯ None: The action recommendation would be made appropriately in the absence of any causal relationship
- ◯ Weak: The action recommendation may be made appropriately had a causal relationship been identified, but it is unclear or possible to come to that recommendation in the absence of any causal inference
- ◯ Moderate: The action recommendation most likely could be made appropriately had a causal relationship been identified, but it is unclear or possible to come to that recommendation in the absence of any causal inference
- ◯ Strong: The action recommendation could only be made appropriately had a causal relationship been identified

Anywhere in text

20. Anywhere in text: Causal disclaimer statements

If there are any statements in the discussion which explicitly mention causality as a cautionary or disclaimer statement, paste them here. Examples may include "correlation does not equal causation", "the observational nature of this study means that causal inferences cannot be drawn", or similar. If not, leave blank.

_____

_____

_____

_____

_____

21. Anywhere in text: Acknowledgement of intent to draw causal inference

If there are any statements in the discussion which explicitly acknowledge an intent to draw causal inference, paste them here. If not, leave blank.

22. Anywhere in text: Is "confounding", "confounders", or "third variable" discussed * or mentioned in relation to the methods, results, and/or interpretation of this study?

Includes "confound*" where * can be any suffix. Explicit word(s) must be included. This must be in reference to the methods, results, and/or interpretation of this study, and not in reference to other studies. Check all that apply.

*Check all that apply.*

- [ ] No, this does not appear in the study manuscript
- [ ] Yes, in the introduction
- [ ] Yes, in the methods section
- [ ] Yes, in the discussion limitations section
- [ ] Yes, elsewhere in the discussion section
- [ ] Other:

23. Additional comments

e.g. other causal sentences not already captured above

## Appendix C

Changes Made to Review Tool After Pre-registration

1. Question wording changes:
    a. In some instances, the word ‘Exposure’ had been used instead of ‘Independent Variable’/’Predictor’; in all instances this was changed to ‘Independent Variable’ or ’Predictor’.
    b. It was made clear that when selecting identifying a linking sentence or action recommendation, the sentence selected must involve psychological capital in its capacity as either the independent/predictor variable or dependent/outcome variable.
    c. The description of Abstract: Primary Linking Sentence and Abstract: Primary Linking Word/Phrase was changed to specify that if there are multiple sentences that equally meet these guidelines, the sentence with the strongest causal language was to be chosen.
    d. The description of Discussion/Conclusion: Primary Linking Sentence was changed to specify that:
        i. The preference for this sentence is the first paragraph of the discussion or conclusions section,
        ii. If there are multiple sentences that equally meet these guidelines, the sentence with the strongest causal language should be chosen,
        iii. If there are none, the second paragraph should be reviewed, and so on until linking sentence is identified.
    e. In the question “Discussion/conclusion: Action recommendation causal implication”, the response option “N/A: No action recommendation(s)

provided in this *abstract*" was corrected to "N/A: No action recommendation(s) provided in this *discussion/conclusion*"

f. The question "Anywhere in text: Is "confounding" or "confounders" discussed or mentioned in relation to the methods, results, and/or interpretation of this study?" was edited to include "or "third variable"".

2. The 'Required' settings on questions were removed where the description of the question said to leave blank if none.
3. The question "Introduction: Causal theory explanation sentence in introduction" & associated rating of causality was removed due to the broadness of question and its lack of relevance to the research objectives.
4. For the question "Introduction/methods: Formal causal model", response options were streamlined by the removal of "equation-based toy model" and "simulation model".
5. After data gathering, "causal directed acyclic graph (DAG)" was removed from the question "Introduction/methods: Formal causal model", as no authors explicitly described their flowcharts as such, however some of these flowcharts with directed arrows might arguably constitute a DAG.

## Appendix D

Changes to data extracted post-completion of data gathering

- The article numbers mentioned in this appendix are the identifiers assigned to each article. Article identifiers, titles, and DOIs can be found online at https://osf.io/w3hd8/?view_only=54150c2ed96b417896b3d7a3e8b1fbe5.
- Following discussion of the use of mediation is observational studies, linking sentences for meditation relationships rated 'None' were changed to 'Weak' due to the inherent causality of such a relationship. This affected 4 linking words. The changes were applied to the following articles.
    a. Article 26 (discussion)
    b. Article 32 (abstract)
    c. Article 36 (abstract)
    d. Article 45 (discussion)
- A second opinion from the primary supervisor of this study was sought for a number of linking language causality ratings. The following articles subsequently had their ratings altered:
    a. Article 10 (abstract): 'weak' became 'none'
    b. Article 10 (discussion): 'moderate' became 'strong'
    c. Article 18 (discussion): 'strong' became 'moderate'
    d. Article 19 (discussion): 'strong' became 'moderate'
    e. Article 19 (action recommendation): 'none' became 'weak'
    f. Article 23 (abstract): 'moderate' became 'weak'
    g. Article 34 (abstract): 'moderate' became 'strong'
    h. Article 35 (discussion): 'strong' became 'weak'
    i. Article 47 (action recommendation): 'strong' became 'weak'

- One change was made to an identified action recommendation. For Article 33, the sentence prior was added to the response as necessary context for the action recommendation causal implication rating.