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Be a hero, be your own best friend: a self-compassion-based PsyCap intervention improves PhD students' well-being

Luisa Solms¹ · Machteld van den Heuvel¹ · Barbara Nevicka¹ · Astrid C. Homan¹

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Abstract

Growing research evidence points towards a mental health crisis in PhD students. High-quality support services for PhD students are scarce as is research on interventions. Inspired by Conservation of Resources theory, we introduce a novel type of PsyCap intervention—a self-compassion-based PsyCap training—that aims to improve PhD students' well-being (i.e., in terms of reducing work pressure and increasing positive affect and support seeking) through PsyCap and self-compassion. 115 PhD students in the Netherlands were randomized to a self-compassion-based PsyCap intervention, a PsyCap-only intervention, or a wait-list control group. Results indicated that the self-compassion-based PsyCap intervention increased self-compassion, reduced work pressure, and increased support seeking in the short term following the intervention. The PsyCap-only intervention increased psychological capital and reduced work pressure in the short term. Notably, increase in self-compassion was a key mechanism through which participants of the self-compassion-based PsyCap intervention, but not the PsyCap-only intervention, experienced improvements in all well-being outcomes over the longer term. Unexpectedly, the self-compassion-based PsyCap intervention increased psychological capital only at follow-up via self-compassion. This study provides initial evidence that developing PsyCap, alongside self-compassion, may take longer but benefits PhD students' well-being and does so more than developing PsyCap alone.

Keywords PhD students · PsyCap · Self-compassion · Well-being · Intervention

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Introduction

Pursuing an academic career is difficult. Academia is increasingly criticized for its heavy workloads, high competition, and publish-or-perish culture (Flaxman et al., 2012; Kinman & Wray, 2014; Ogbonna & Harris, 2004; see also for a review, Schmidt & Hansson, 2018), leading to growing concerns about academics' mental health. While the problem has been recognized around the globe and across all academic ranks (see for a review, Urbina-García, 2020), it is most apparent in early-career researchers. PhD students are twice as likely to suffer from mental health problems than their senior colleagues (Levecque et al., 2017) and the prevalence of anxiety and depression in PhD students is reportedly six times higher compared to the general population (Evans et al., 2018). A decline in PhD students' well-being is not only problematic for the PhD students themselves, but also for generation of scientific knowledge and evidence-based solutions for society as a whole because it impacts productivity (Danna & Griffin, 1999) and increases the likelihood of losing research talent via drop-outs (Alves et al., 2023; Virtanen et al., 2017). Consequently, there is a need to design and implement evidence-informed intervention strategies that can help safeguard the well-being of PhD students.

One way to improve PhD students' well-being is to develop personal resources (Barry et al., 2019; Marais et al., 2018). According to Conservation of Resources (COR) theory, a prominent theory of stress and well-being, personal resources are aspects of the self that give people a sense of control and help them cope with their environment successfully (Hobfoll et al., 2003). Through specific personal resources people can overcome challenges directly or indirectly by gaining access to additional resources that help solve the issue. Consequently, personal resources should help PhD students to meet stressful demands and maintain their well-being. Here, we argue that PhD students' work is cognitively (e.g., high workload) and emotionally (e.g., experience of failure) demanding, and as such requires a blend of both cognitive and emotion-focused strategies and propose that a combination of two personal resources, that is psychological capital (PsyCap) and self-compassion will provide just that.

Indeed, according to two recent review studies (Mackie & Bates, 2019; Watson & Turnpenny, 2022) interventions aimed at building PhD students' psychological resources were particularly promising to improve PhD students' well-being. Although none of the interventions focused on building PsyCap or self-compassion in particular, one study reported an increase in PhD students' PsyCap as well as a reduction in depression after a mindfulness-based training intervention (Barry et al., 2019). Likewise, a self-care intervention including self-compassion training led to a reduction in PhD students' anxiety (Marais et al., 2018). Here, we aim to build on those studies by arguing that interventions aimed at developing PhD students' PsyCap and self-compassion should not only improve PhD students' well-being but should also lead to an increase in personal resources. Unlike previous studies, we also aim to use mediation analyses to examine whether an increase in personal resources (i.e., PsyCap, self-compassion) drives changes in well-being outcomes over time. To that end, we included a follow-up measurement three months after the interventions.

PsyCap is a set of four personal resources, namely hope, self-efficacy, resilience and optimism (HERO), that bolsters people's motivation, enhances positive work-related cognitions and enables them to take positive action in order to achieve their work-related goals (Avey et al., 2011; Luthans et al., 2007). For example, through PsyCap, PhD students set ambitious work-related goals and pursue those by cultivating a positive mindset and putting in sustained attention and effort. Consequently, PsyCap is well-suited to help PhD

students manage their cognitive demands. Yet, when PhD students set ambitious goals and seek challenge, making mistakes and experiencing failure is inevitable. These experiences need to be dealt with in order for PhD students to maintain their functioning throughout their doctoral years. In these instances, PsyCap alone might not be sufficient, but PhD students might need additional resources. Self-compassion, which refers to a positive attitude towards oneself in the face of suffering or stress (Neff, 2003) might be particularly helpful for PhD students to work through those challenges and to maintain their well-being. Self-compassion involves treating oneself with the same warmth, care, and concern that one would show to a good friend (Neff, 2011a) and is reportedly lacking in PhD students—who have a natural tendency to strive for excellence and to react with self-criticism when unable to meet their high standards (Moate et al., 2019). Such self-criticism is dysfunctional as it activates negative self-focused emotions (e.g., anger, sadness, shame) which can narrow people’s cognitive scope, and compromise coping and well-being. In order to increase well-being, PhD students might benefit from replacing their self-criticism by showing kindness and understanding toward themselves (Moate et al., 2019). By helping PhD students to be accepting of and supportive in response to failure, their own shortcomings, and insecurities, self-compassion serves exactly this purpose. Therefore, it is the combination of PsyCap and self-compassion rather than PsyCap alone that we expect to benefit PhD students’ well-being most.

Additionally, we propose that self-compassion serves as a *key resource*—a resource that helps to select, alter, and implement other resources (Thoits, 1994)—and as such can help boost PhD students’ PsyCap. Specifically, when under stress, PhD students may find it difficult to generate or use their PsyCap resources adequately (Bakker & De Vries, 2020). In these instances, self-compassion may foster a positive self-attitude, which may benefit the development of PsyCap (Hobfoll, 2011). In sum, we expect that combining development of PsyCap and self-compassion (1) improves PhD students’ well-being and (2) is more beneficial than developing PsyCap alone. We, furthermore, explore whether (3) self-compassion may help to boost PsyCap.

To equip PhD students with PsyCap and self-compassion, we follow Luthans et al.’s (2006) popular approach to PsyCap development: a short, focused Psychological Capital Intervention (PCI) that uses cognitive-behavioral activities to develop the HERO resources. We designed and evaluated two online training interventions (both with a duration of five weeks): first, a PsyCap training and, second, a self-compassion-based PsyCap training which extends the PsyCap training with self-compassion practice. We examine intervention effects on three well-being outcomes. Specifically, we use a broad conceptualization of well-being distinguishing between affective well-being (i.e., positive affect), cognitive well-being (i.e., work pressure), and social well-being (i.e., support seeking behavior), in line with its multidimensional nature (Van Horn et al., 2004). Notably, these dimensions and respective outcomes are not exhaustive but were selected based on what we considered most relevant and realistic change objectives for PhD students, which we elaborate on below. Outcomes were measured directly after the completion of interventions. In the following sections, we first offer a brief description of what PsyCap entails and how it can be developed to foster PhD students’ well-being. Next, we focus on how self-compassion can complement the positive effects of PsyCap on well-being, followed by a description of how self-compassion can better enable the development and use of PsyCap.

We aim to make three contributions to the literature. First, we extend the application of COR theory and the literature on PsyCap and self-compassion to propose that developing self-compassion alongside PsyCap helps improve well-being (i.e., positive affect, work pressure, and support seeking) more so than developing PsyCap alone. Second, by

proposing that self-compassion practice may boost PsyCap development, we respond to prior work that has called to study *how* resources interact in producing positive outcomes (Halbesleben et al., 2014). Finally, by designing a novel, brief, and customized online PsyCap intervention and testing its effectiveness in a sample of PhD students, we aim to provide timely knowledge and guidance to higher education institutions that aim to support their PhD students with evidence-based interventions.

PsyCap and PsyCap interventions

PsyCap is defined as “an individual’s positive psychological state of development” (Luthans et al., 2006, p. 3) consisting of four major components: hope, self-efficacy, resilience, and optimism. *PsyCap hope* is a positive motivational state that involves agency (goal-directed energy) and pathways, that is, routes to goals (Luthans et al., 2006). Hopeful people identify goals and are motivated to and persistent in achieving them by determining goal-directed pathways (Snyder, 2000). *PsyCap self-efficacy* is defined as “one’s confidence about one’s abilities to mobilize the motivation, cognitive resources, and courses of action needed to successfully execute a specific task within a given context” (Stajkovic & Luthans, 2002, p. 126). In contrast to Bandura’s (1997) task-specific definition of self-efficacy, PsyCap self-efficacy is conceptualized as a general sense of being effective at work. *PsyCap resilience* is defined as the “positive psychological capacity to ‘bounce back’ from adversity, uncertainty, conflict, failure, or even positive change, progress and increased responsibility” (Luthans, 2002, p. 702). Therefore, resilience is not limited to negative events but can also include positive events that are perceived as challenging. Finally, drawing on attribution theory (Seligman, 1998), *PsyCap optimism* is defined as an explanatory style that uses internal, stable, and global causes (e.g., scientific writing skills) to explain positive events (e.g., paper acceptance) and external, unstable and situation-specific causes (e.g., lack of support) to explain negative events (e.g., paper rejection). In addition to positively attributing events, optimists make realistic estimations and thus understand what can and cannot be accomplished in a particular situation. Taken together, people with high levels of PsyCap energetically and creatively pursue their goals (hope), are confident about their abilities (self-efficacy), can cope with challenging events (resilience), and have a positive, yet realistic sense of optimism.

Through its strong focus on personal goals, PsyCap can play a key role in overcoming professional and personal challenges in PhD students’ career success (Luthans et al., 2012; Martínez et al., 2019). As people’s PsyCap is malleable, it can be developed and strengthened through interventions, such as the PCI (Luthans et al., 2006; see also Da Costa et al., 2021) and broader positive psychology interventions (Barry et al., 2019). We, therefore, propose that PsyCap can be developed in PhD students to facilitate goal setting and goal attainment (building hope; Snyder, 2000), mastery (building self-efficacy; Bandura, 1997), coping with challenge (building resilience; Masten, 2001) and beneficial attributions (building optimism; Seligman, 1998). Thus, we formulate our first hypothesis:

Hypothesis 1: PhD students participating in the PsyCap-only intervention report higher PsyCap levels at post-intervention compared to (H1a) their pre-intervention levels and (H1b) the wait-list control group.

The effects of PsyCap on PhD students’ well-being

The development of PsyCap has been associated with beneficial well-being outcomes (Lupşa et al., 2020; Luthans et al., 2006). These effects can be explained by Conservation

of Resources (COR) theory which proposes that personal resources help to build and protect higher-order resources, such as well-being. Specifically, people may use their PsyCap resources, such as their self-efficacy or resilience, in order to gain additional resources (i.e., to increase their well-being) and to offset potential loss of resources (i.e., to avoid a decline in well-being). Given the intense cognitive (e.g., completing course work, writing a dissertation) and emotional demands (e.g., dealing with negative feedback and rejection) that are inherent in doing a PhD (Schmidt & Hansson, 2018), it is not difficult to imagine that PhD students feel depleted and in need for resources. To help them replenish old and build new resources, which can help promote well-being and prevent further or future well-being declines, resource-based training interventions have been suggested as a key strategy (Halbesleben et al., 2014). Consequently, participating in a training intervention that equips PhD students with resources that help cope with both cognitive and emotional demands should improve PhD students' well-being. Below, we describe how PsyCap resources can influence PhD students' well-being in terms of increasing positive affect, reducing work pressure, and increasing support seeking behavior—which are core affective, cognitive, and social well-being outcomes (Van Horn et al., 2004). By examining intervention effects on these proximal well-being outcomes, we aim to increase our understanding of how interventions can prevent more severe and less malleable outcomes such as chronic stress and burnout.

PsyCap and positive affect

For PhD students, experiencing positive affect¹ is crucial to maintain motivation throughout the doctoral years. However, PhD students are confronted with various challenges, such as high workloads, interpersonal conflict, negative feedback, job insecurity, or limited support which can hamper positive affect. PsyCap can help deal with such challenges by allowing PhD students to adopt a positive approach to potentially threatening situations (Avey et al., 2008).

Through hope, PhD students can set positive or 'approach' goals and generate pathways that lead to their goals. As they perceive progress in goal-pursuit activities, positive affect should follow (Snyder et al., 2002). Relatedly, self-efficacy equips PhD students with confidence in own abilities, and as such should elicit positive affect (Bandura, 1991). Through resilience, PhD students can use and increase their resources to reduce the perceived risk of a situation (Masten, 2001). Therefore, a situation that appeared uncontrollable at first can be perceived as manageable, which should foster positive affect. Lastly, through optimistic attributions (i.e., explaining a negative event in terms of external, temporary, and situation-specific factors; Seligman, 1998), PhD students can view setbacks as temporary and manageable. This can help them to remain confident in themselves and their goal pursuit, and thereby increase positive affect. Thus, we expect PsyCap to increase positive affect.

PsyCap and perceived work pressure

Due to high workload and high performance expectations, many PhD students experience strain or pressure at work (Van Rooij et al., 2021)—a subjective state of tension associated with the execution of current or future work tasks (Roe & Zijlstra, 2000). Equipping PhD

¹ By using the term "affect", we refer to a subjective sense of positivity or negativity that arises from an experience (Russel & Carroll, 1999).

students with PsyCap can help them to manage their work demands effectively and as such may help to decrease their work pressure. This is in line with COR theory (Hobfoll, 1989) which posits that personal resources help employees adapt to challenging work environments successfully (Van den Heuvel et al., 2010, 2020).

PsyCap hope may enable PhD students to deal with high workloads by equipping them with goal setting and planning skills, such as the use of specific approach goals and the generation of multiple pathways to goals. Additionally, through agency, PhD students will be motivated and willing to carry out the actions needed for goal pursuit. Moreover, by increasing analytical thinking and problem-solving skills (Wood & Bandura, 1989), self-efficacy can help PhD students feel more confident about managing their work tasks successfully. Through resilience, people can mobilize resources, in order to cope with a threatening situation (Masten, 2009), such as the experience of work pressure. For instance, a PhD student may mobilize personal time and energy in order to participate in a training aimed at improving time management skills. Lastly, as optimism equips people with the generalized expectancy that good things happen (Scheier & Carver, 1985), optimistic PhD students should perceive themselves as capable of managing the work tasks. Taken together, we argue that PsyCap reduces perceived work pressure.

PsyCap and support seeking

Pursuing a PhD is a long and difficult project and therefore having people to turn to for encouragement, support, and advice is crucial for PhD students' well-being. In order to maintain their social well-being, PhD students need to actively seek support from peers, colleagues, and other professionals (Cornér et al., 2018; Pyhältö, 2018). Here, we argue that PsyCap can help PhD students to engage in these behaviors.

Specifically, PsyCap hope allows people to identify sources of support, generate pathways to gain support, and mobilize the mental energy to reach that goal. The self-efficacy component of PsyCap allows people to feel confident in social situations, and as such enables them to actively seek and cultivate social interactions and supportive social networks (Alessandri et al., 2009; Holahan & Holahan, 1987). Resilience enables people to cope with setbacks, which can help PhD students deal with support that is inadequate or ineffective (Masten, 2009), for example by seeking alternative sources of support. Finally, through PsyCap optimism, people believe that a situation can be changed for the better, which ultimately boosts agency and people's willingness to search for solutions (Mikus & Teoh, 2022), including support seeking. Indeed, people with a more optimistic personality and high self-esteem are more likely to actively seek support for completing challenging tasks (Hardré, 2003). In sum, developing PsyCap is expected to increase support seeking.

Taken together, we formulate the following hypothesis for our three well-being outcomes:

Hypothesis 2: PhD students participating in the PsyCap-only intervention report higher levels of well-being (increased positive affect, reduced work pressure, increased support seeking) at post-intervention compared to (H2a) their pre-intervention levels and (H2b) the wait-list control group.

The effects of self-compassion on PhD students' well-being

While PsyCap enables people to persevere and succeed at challenging tasks, it is not primarily concerned with how people deal with difficult feelings. Yet, work life is fraught

with emotionally demanding situations that people need to cope with in order to succeed at their jobs. For example, a PhD student might receive harsh criticism for their work as part of the anonymous peer-review process. A strategy that can provide a functional approach to dealing with such negative experiences is self-compassion. Self-compassion is a personal resource that has been broadly defined as compassion directed to oneself (Neff, 2003). Self-compassion involves three elements: *self-kindness*, being kind to oneself rather than self-judgmental in moments of stress or suffering; *common humanity*, recognizing difficulties as shared aspects of living rather than personal inadequacy that isolates you from others; and lastly, *mindfulness*, being aware and accepting of unpleasant experiences rather than ignoring or ruminating on them (Neff, 2011b). Based on these underlying elements, self-compassionate people show more supportive reactions in response to unpleasant events (self-kindness), place their problems into perspective by recognizing that all people suffer (common humanity), and are more accepting of their negative experiences which prevents rumination (mindfulness; Leary et al., 2007).

Given that PhD students are relatively inexperienced at their job, and are learning to become scientists, making mistakes and experiencing failure is inevitable (Simpson & Maltese, 2017). Yet, due to the academic pressures, they often adopt exceptionally high standards and show perfectionistic tendencies that can lead to overcommitment and increased self-judgment when expectations are not met (Moate et al., 2019; Richardson et al., 2020). Additionally, as PhD students might perceive mistakes as something that is unique to them rather than something that is part of learning during the PhD process or the human condition in general, they could withdraw from other PhD students who presumably are more successful in their PhD. Such responding is not only highly dysfunctional as it lacks strategies for solutions, it also exacerbates the problem by increasing PhD students' anxiety, fear of failure, and isolation. By helping PhD students to accept inadequacies and failures, self-compassion is likely to benefit PhD students in their emotional coping.

Additionally, we propose that self-compassion may also help boost PsyCap resources. In line with the idea that some resources are (especially) helpful for generating other resources (Hobfoll, 2002), we argue that self-compassion offers an effective way to cope with stressful experiences brought on by the high demands of obtaining a PhD and as such can help PhD students to better implement and consequently benefit from their PsyCap. Specifically, by allowing PhD students to engage in challenging goal attainment activities without fear (PsyCap hope), promoting confidence in own abilities by offering kindness and support (PsyCap self-efficacy), fostering awareness of and improvement after failure (PsyCap resilience) and promoting positive attributions by recognizing that all people are imperfect (PsyCap optimism), self-compassion will help PhD students to approach challenge in a functional way. Supporting our expectation, prior research has shown that self-compassion was linked to some of the PsyCap components when measured through self-reports (i.e., optimism; Neff et al., 2007, self-efficacy; Iskender, 2009) and when developed through an intervention (Smeets et al., 2014). Given that self-compassion is malleable and can be developed through brief training interventions (Beaumont et al., 2016; Franco & Christie, 2021; see also Dundas et al., 2017; Ferrari et al., 2019), we propose that developing self-compassion alongside PsyCap in PhD students should boost their PsyCap development.

Hypothesis 3: PhD students participating in the self-compassion-based PsyCap intervention report higher PsyCap and self-compassion levels at post-intervention compared to (H3a) their pre-intervention levels, (H3b) the wait-list control group and (H3c) the PsyCap-only intervention group.

Finally, because we expect self-compassion to be crucial both in terms of promoting PhD students' well-being (Paucsik et al., 2022; Zessin et al., 2015) and fostering PsyCap, we argue that developing PsyCap, in conjunction with self-compassion, should improve PhD students' well-being in terms of increasing positive affect, reducing work pressure, and increasing support seeking more so than PsyCap alone. We formulate our final hypothesis as follows:

Hypothesis 4: PhD students participating in the self-compassion-based PsyCap intervention report higher well-being (i.e., increased positive affect, decreased work pressure, increased support seeking) at post-intervention compared to (H4a) their pre-intervention levels, (H4b) the wait-list control group and (H4c) the PsyCap-only intervention group.

Method

Participants

Participants were PhD students, who worked in five different faculties of a large university in the Netherlands. Initially, 175 PhD students indicated interest in our study after an e-mail invitation and communication efforts via internal channels (e.g., faculty newsletter). Of these, 162 PhD students responded to our request to fill in an online questionnaire (93% response rate at pre-intervention). Twelve participants² were excluded because they did not meet the inclusion criteria. Additionally, we excluded two participants who switched from the control group to the intervention group. For ethical reasons, we did not want to reject their request, however, to minimize the risk that those participants influenced our findings by differing on unmeasured variables (e.g., training motivation), we removed them from the analyses. Consequently, we had 148 eligible participants whom we randomly assigned to either one of two intervention groups (i.e., PsyCap-only and self-compassion-based PsyCap group) or a wait-list control group. Eighteen participants were allowed to switch between intervention groups if their schedule required it. Notably, participants switched before the start of the intervention and participants did not know that there were different interventions. We only communicated that a well-being intervention was offered to PhD students at different time points throughout the year. Consequently, the sample consisted of $n = 43$ in the PsyCap-only group, $n = 46$ in the self-compassion-based PsyCap group, and $n = 59$ in the wait-list control group. Due to unforeseen reasons (e.g., illness, scheduling conflicts), several participants discontinued their participation after the pre-intervention questionnaire ($n = 33$) or the post-intervention questionnaire ($n = 14$), which resulted in a sample of 115 participants at post-intervention³ (T2) and a sample of 101 participants at

² Eight participants did not give consent and four participants filled in the survey only partly. Of these four, three participants completed the background measures only. Another participant failed to complete important primary and secondary outcome measures. Both giving consent and completing the key outcome measures at T1 were specified as inclusion criteria in our preregistration.

³ To rule out the possibility that participants who completed the training differed meaningfully from those who dropped out after T1, we compared our final T2 sample—those who completed both the T1 and T2 measurement—to those participants who only completed the T1 measurement and dropped out after on our key outcome measures. Analyses indicated that there was no difference in psychological capital, self-compassion, positive affect, work pressure, or support seeking at baseline, $F_s \leq 1.34$, $p_s \geq .249$.

follow-up (T3). Given that our preregistered hypotheses were concerned with the immediate impact of the intervention on proximal well-being outcomes, all hypotheses tests were conducted using the T2 sample. The T3 sample was included in mediation analyses because we were interested in how personal resources at post-intervention (T2) related to outcomes at follow-up (T3). Given our argument that self-compassion might be a key resource in PsyCap development, we also conducted an exploratory mediation analysis to examine whether changes in self-compassion directly after the intervention (T2) increased PsyCap at follow-up (T3). In Fig. 1, the flow from pre-intervention (T1) to post-intervention (T2) and follow-up (T3) is depicted.

Of the T2 sample (i.e., participants that completed both the pre-intervention and the post-intervention questionnaire), 73 participants were female (63.5 %) and 39 were male (33.9 %). Three participants (2.6 %) did not disclose their gender. On average, PhD students were 29.66 years old ($SD = 5.59$) and at the beginning of the third year of their PhD ($M = 2.20$, $SD = 1.46$). Most participants were PhD students from the natural sciences (35.7%), social sciences (35.7%), or humanities (20.9%), while PhD students from economics (6.1%) and law (1.7%) were less frequently represented. The majority had a formal employment agreement with a university (87.8%) and worked full-time (86.1%). In total, PhD students from 35 nationalities were represented, with Dutch (27 %), German (11.3%) and Chinese (10.4%) being the biggest groups. More details of the sample's demographic characteristics are shown in Table 1.

Procedure

The study was conducted between the spring and fall of 2021 as part of a bigger university-wide research project on academic well-being. Intervention groups started the training in April 2021 while the wait-list control group started the training in September 2021. PhD students were informed that the university was offering an online well-being intervention for PhD students as part of a university-wide project to promote employee well-being. The intervention consisted of a single online workshop (week 1) and four weeks of home practice (week 2- week 5). To make sure that as many participants as possible could join, the same workshop was offered at two different time points. Ultimately, each intervention group (PsyCap-only and self-compassion-based PsyCap) consisted of two training groups. The study was approved by the Faculty's Ethics Review Board (2021-WOP-13314). Participants were informed that participation in the study was voluntary and that they could withdraw from the study at any time. Informed consent was collected at all three measurement points.

Participation schedule

At the start of the study, all registered participants received an e-mail including a link to an online questionnaire via the Qualtrics software. The randomization procedure was embedded such that participants who completed the survey were automatically assigned to one of two intervention groups or the wait-list control group. The questionnaire served as a pretest of PhD students' PsyCap, self-compassion, and well-being. Additionally, the questionnaire covered PhD students' demographics, PhD specifics (e.g., year of training), and work characteristics (i.e., publication pressure, work-home conflict, learning opportunities). Work

Table 1 Demographics Across Different Groups

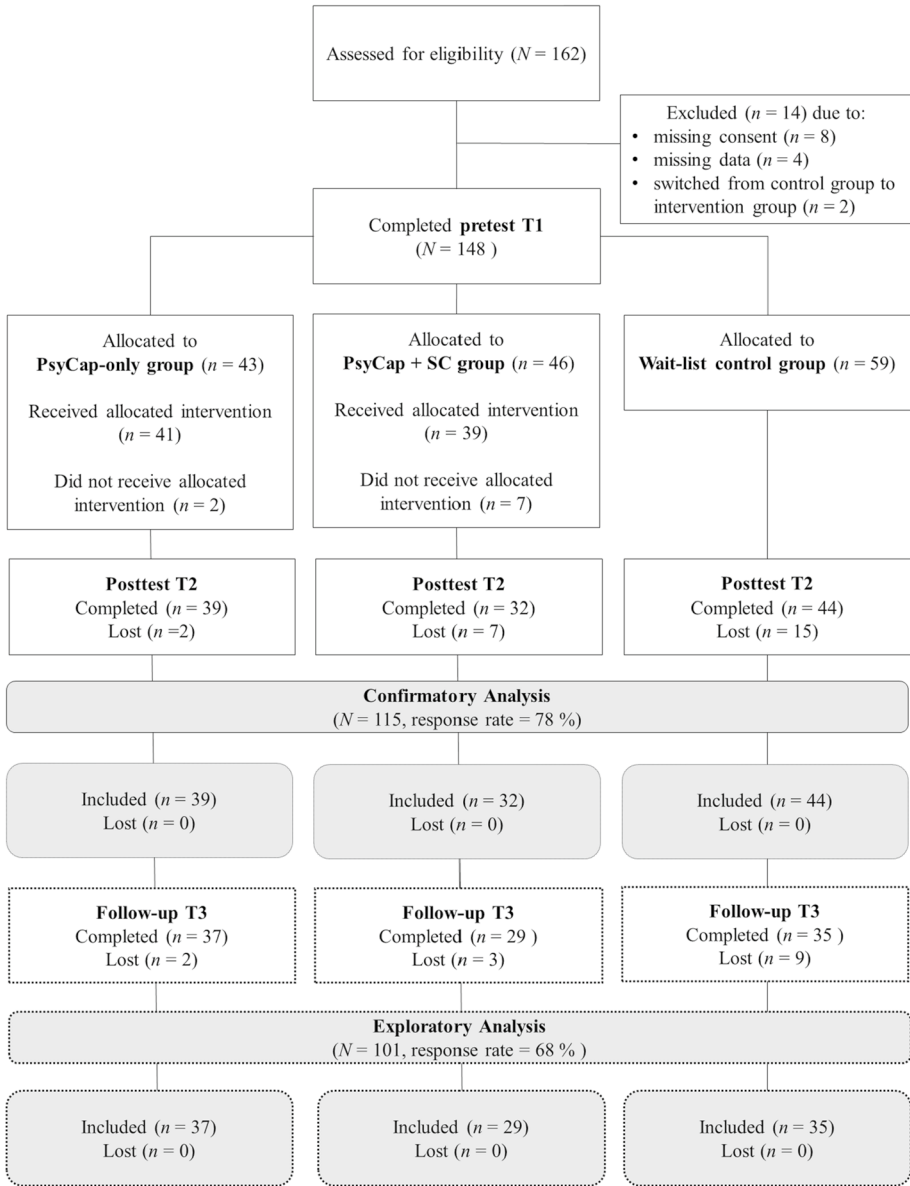
Characteristic	PsyCap-Only (<i>n</i> = 39)		PsyCap + SC (<i>n</i> = 32)		Control (<i>n</i> = 44)		Full sample (<i>N</i> = 115)	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Gender								
Female	18	46.2	26	81.3	29	65.9	73	63.5
Male	20	51.3	5	15.6	14	31.8	39	33.9
Other/no answer	1	2.6	1	3.1	1	2.3	3	2.6
Relationship status								
Single	18	46.2	7	21.9	8	18.2	33	28.7
Married/partnered	20	51.3	20	62.5	33	75.0	73	63.5
Other	1	2.6	5	15.6	3	6.8	9	7.8
Living with partner/others								
Yes	23	59.0	19	59.4	28	63.6	70	60.9
No	16	41.0	13	40.6	16	36.4	45	39.1
Having children living in the same household								
Yes	3	7.7	2	6.3	6	13.6	11	9.6
No	36	92.3	30	93.8	38	86.4	104	90.4
Faculty affiliation								
Sciences	21	53.8	7	21.9	13	29.5	41	35.7
Social Sciences	9	23.1	15	46.9	17	38.6	41	35.7
Humanities	8	20.5	8	25.0	8	18.2	24	20.9
Economics	0	0	2	6.3	5	11.4	7	6.1
Law	1	2.6	0	0	1	2.3	2	1.7
Employment								
Full-time	34	87.2	30	93.8	35	79.5	99	86.1
Part-time	5	12.8	2	6.3	9	20.5	16	13.9
Funding								
University-funded	33	84.6	30	93.8	38	86.4	101	87.8
Self-funded	6	15.4	2	6.3	6	13.6	14	12.2

Note. SC = self-compassion; three participants did not disclose their gender; people that indicated to be in a casual relationship are summarized under 'Other'

characteristics were assessed to ensure that participants did not differ in work demands and resources at pre-intervention.⁴

After completing the pre-test questionnaire, we invited the intervention groups for a kick-off training workshop. The post-intervention assessment (T2) was completed directly after the four-week home practice, and the follow-up assessment (T3) was completed three months after the home practice had finished. To compensate participants at post-intervention, participants could win a lottery (six vouchers of €25). At follow-up, all participants received a voucher of €5. For an overview of the intervention schedule, see Table S1 in the Supplemental Materials (see Section 1).

⁴ There were indeed no differences at pre-intervention. Results can be requested from the authors.



Note. SC = self-compassion.

Fig. 1 Flow Chart of Study Design and Response Rates

Psychological capital training interventions

The Psychological Capital Training is a skills-based training designed specifically for PhD students. The training is based on Luthans et al.'s (2006) micro-intervention model (see also Luthans et al., 2008) and includes a variety of cognitive behavioral techniques aimed at building PhD students' hope, self-efficacy, resilience, and optimism, or the HERO within (Luthans & Youssef-Morgan, 2017). For all content, exercises, and homework assignments we made use of empirically supported materials adjusted for an online training format. Below, we provide a general overview of what was offered to the participants. A detailed description of the content of the training intervention can be found in the Supplemental Materials (see Section 2).

At the start of the intervention, participants received a 3.5-hour online workshop. The workshop was facilitated by the second author who is also a certified trainer and coach. The workshop contained information and exercises on the core PsyCap components and their theoretical and empirical underpinnings. Exercises were done both individually and in groups of three to five PhD students. These so-called *buddy groups* were implemented as an incentive and a source of peer support during the intervention. The workshop was followed by four weeks of self-practice. During this period, participants received a weekly explainer video⁵ and a homework assignment (see Figure S1 in Section 2 in the Supplemental Materials). The videos and the homework assignments were designed to help participants transfer knowledge and skills from the workshop to the work context. In order to stimulate exchange outside of the buddy groups, we used an online *mood board*, a virtual bulletin board that could be filled with messages, gifs, videos, and photos. The researchers stimulated self-practice and the use of the mood board by posting weekly video messages.⁶ Finally, to assist participants in managing the various aspects of the intervention and to help them keep track of their own progress, participants received a weekly *Reflection Diary*—a short online questionnaire covering participants' engagement⁷ in the intervention.

Participants in the self-compassion-based PsyCap training went through the same process as described above. This means that participants received a 3.5-hour workshop at the beginning of the intervention followed by a period of self-practice. While the self-compassion-based PsyCap intervention was similar to the PsyCap-only intervention with regard to format and length, the content presented during the workshop partly differed. During the workshop, participants first learned about self-compassion and its three components (i.e., self-kindness, common humanity, mindfulness), after which they got an opportunity to practice self-compassion. Specifically, participants engaged in a self-compassion break, a brief self-compassion meditation, in which they reflected on and applied the three components of self-compassion to a stressful event in their own lives. Tapping into the mindfulness component of self-compassion, participants were encouraged to acknowledge their own feelings

⁵ Explainer videos were approximately three minutes long and were designed to provide participants with an easy-to-understand explanation of the PsyCap components. The content of the videos was developed by the researchers while the animation was designed by a professional animation developer. The videos will be made available upon reasonable request.

⁶ The videos included a brief review of the PsyCap component and strategies covered in the weekly PsyCap Boost and a preview of the component that would be covered next. Researchers also complimented participants on their efforts and the progress made.

⁷ Given that the reflection diary was not intended to be a part of the study, we did not request participants to fill it out. In the end, on average, thirteen participants filled out the reflection diary survey. Questions covered use of explainer videos and experienced usefulness, progress on homework assignments, buddy group involvement, use of mood board, application of knowledge and skills in daily (work) lives, and other comments.

(e.g., frustration) without being judgmental and without getting carried away by negative feelings. Furthermore, they were asked to remind themselves of their common humanity (e.g., understanding that suffering is part of the universal human condition) and to practice self-kindness, that is being accepting and understanding towards themselves. Next, participants were introduced to PsyCap and completed exercises to develop their PsyCap. Exercises were identical compared to the PsyCap-only intervention but included a “self-compassion add-on”, that is specific instructions as to how to apply self-compassion when engaging with the materials. For example, as a part of developing PsyCap hope, participants in both intervention groups were instructed to brainstorm obstacles to their goals and how to overcome these. Additionally, participants in the self-compassion-based PsyCap intervention were instructed to be self-compassionate, that is to be supportive and understanding when faced with obstacles. A full description of the exercises and the respective self-compassion add-on is described in the Supplemental Materials (Section 2).

Measures

All study variables were assessed at three measurement points (i.e., at T1, T2, and T3). The demographic variables and PhD specifics were only assessed at T1. Additional pre-registered outcome measures, such as work engagement, emotional exhaustion, and task accomplishment are not included in the paper. We report the findings for these measures (i.e., changes from pre-intervention to post-intervention and follow-up) in the Supplemental Materials (see Section 9). Emotional exhaustion and work engagement are excluded here because they are more distal well-being outcomes that are less likely to be influenced through the interventions in the short term (Meyers & Van Woerkom, 2017). Also, we believe that given our paper’s focus on PhD students’ well-being, findings on task accomplishment are outside the scope of this paper. Finally, for purposes of brevity, we report relevant findings for measures that were included for exploratory purposes (i.e., goal effort, goal proximity) in Section 9 of the Supplemental Materials.

Personal resources

Psychological Capital was measured with a modified version of the 24-item Psychological Capital Questionnaire (PCQ-24; Luthans et al., 2007). We replaced the self-efficacy subscale with the Short Version of the Occupational Self-Efficacy Scale (Rigotti et al., 2008) because the original items were strongly tied to a managerial work setting and, hence, did not fit our target group (e.g., “I feel confident contributing to discussions about the company’s strategy”). Example items are: “There are lots of ways around any problem” (Hope), “I feel prepared for most of the demands in my job” (Self-efficacy), “When I have a setback at work, I have trouble recovering from it, moving on” (reverse-coded; Resilience) and “When things are uncertain for me at work, I usually expect the best” (Optimism; 1 = *strongly disagree*, 6 = *strongly agree*). Cronbach’s alpha ranged from .90 to .93 for the three measurement points. Given our main interest in ‘overall PsyCap’, we used a total PsyCap score rather than subscale scores.

Self-Compassion was assessed using the six-item State Self-Compassion Scale Short Form (SSCS-SF; Raes et al., 2011). We asked participants to indicate how well each statement applied to them in the past month. An example item is “I’m giving myself the caring and tenderness I need” (1 = *not at all true for me*, 5 = *very true for me*). Cronbach’s alpha ranged from .74 to .78 for the three measurement points. Given our main interest in ‘overall self-compassion’, we used a total self-compassion score rather than subscale scores.

Well-being outcomes

Positive Affect was measured with the positive affectivity subscale⁸ of the Job-related Affective Well-being Scale (JAWS; Van Katwyk et al., 2000). We asked participants to indicate for ten emotions (e.g., excitement) how often they felt them during work (1 = *never*, 5 = *very often*). Cronbach's alpha ranged from .80 to .86 for the three measurement points.

Work Pressure was assessed with the 13-item Tilburg Work Pressure Questionnaire (T-WPQ; Roe & Zijlstra, 2000). We modified the items slightly to the context of PhD students. An example item is "I have the feeling that I'm under pressure in my doctoral studies" (1 = *strongly disagree*, 7 = *strongly agree*). Cronbach's alpha ranged from .84 to .88 for the three measurement points.

Support Seeking was measured using the eight-item Instrumental Support Seeking subscale from the Proactive Coping Inventory (PCI; Greenglass et al., 1999). An example item is "I try to talk and explain my stress in order to get feedback from my friend" (1 = *not true at all*, 4 = *completely true*). Cronbach's alpha was .85 for all three measurement points.

Transparency statement

We describe our sampling plan, all data exclusions, all measures, and both interventions in the study, and we adhered to the APA ethical standards. The Supplemental Materials and analysis code are available on the Open Science Framework at https://osf.io/7498j/?view_only=92403f28d1f44e3fbf423f02db59f01a and intervention materials are available upon request from the authors. Data are not available publicly due to their sensitive nature but can be received from the authors upon request. Data were analyzed using IBM SPSS Statistics (Version 25) and the PROCESS macro (Hayes, 2012). The study design, hypotheses, and main analyses were preregistered on [AsPredicted.org](https://aspredicted.org/L66_848) (https://aspredicted.org/L66_848) after data collection had started. Deviations from the preregistration are described in the manuscript.

Results

Correlations of the key study and outcome variables can be found in Table 2. To make sure that the PsyCap-only group, the self-compassion-based PsyCap group⁹, and the wait-list control group did not differ on important variables (i.e., personal resources, well-being outcomes) at pre-intervention (T1), we conducted two separate multivariate analyses of covariance. As can be seen in Table 3, there were no differences in personal resources, $F_s \leq 0.71$, $ps \geq .495$, and well-being outcomes, $F_s \leq 1.42$, $ps \geq .245$. Also, there were no differences in work characteristics (i.e., publication pressure, work-home conflict, learning

⁸ Given our interventions' focus on generating positive resources, we focused on positive affect (rather than negative affect) as an indicator of PhD students' affective well-being. Nevertheless, other outcome measures such as work pressure might capture PhD students' experiences of negative affect.

⁹ We additionally tested for differences in outcomes at pre-intervention between training groups that together constituted an intervention group. A multivariate analysis of covariance showed that there were no differences in personal resources or well-being outcomes at pre-intervention (T1) between the two PsyCap-only training groups, $F_s \leq 1.51$, $ps \geq .226$, nor between the two self-compassion-based PsyCap training groups, $F_s \leq 1.37$, $ps \geq .251$.

Table 2 Means, Standard Deviations, and Correlations of the Key Study Variables

Variable	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Gender ^a	0.65	0.48	-															
2. PsyCap T1	3.86	0.58	.030	-														
3. PsyCap T2	3.99	0.62	.082	.674**	-													
4. PsyCap T3	4.01	0.64	-.068	.630**	.730**	-												
5. Self-compassion T1	2.90	0.76	-.068	.528**	.319**	.352**	-											
6. Self-compassion T2	3.12	0.72	-.021	.339**	.593**	.557**	.470**	-										
7. Self-compassion T3	3.13	0.75	.083	.271**	.356**	.578**	.447**	.629**	-									
8. Positive affect T1	2.95	0.66	.088	.701**	.580**	.538**	.365**	.352**	.351**	-								
9. Positive affect T2	3.05	0.68	.141	.449**	.754**	.524**	.133	.523**	.313**	.573**	-							
10. Positive affect T3	3.11	0.63	.017	.403**	.505**	.658**	.055	.406**	.452**	.604**	.651**	-						
11. Work pressure T1	4.97	0.88	.159	-.488**	-.226*	-.280*	-.576**	-.357**	-.323**	-.463**	-.195	-.266**	-					
12. Work pressure T2	4.75	0.87	.166	-.390**	-.396**	-.401**	-.314**	-.532**	-.357**	-.415**	-.464**	-.431**	.677**	-				
13. Work pressure T3	4.57	0.94	.127	-.210*	-.296**	-.457**	-.243*	-.459**	-.561**	-.346**	-.353**	-.546**	.523**	.651**	-			
14. Support seeking T1	2.84	0.59	.375**	.199*	.154	.162	.279**	.277**	.206*	.216*	.227*	.246*	-.175	-.166	-.091	-		
15. Support seeking T2	2.93	0.55	.388**	.152	.168	.259**	.163	.338**	.230*	.147	.266**	.293**	-.004	-.058	-.064	.734**	-	
16. Support seeking T3	2.94	0.53	.349**	.229*	.281**	.357**	.211*	.361**	.310**	.337**	.376**	.436**	-.131	-.194	-.170	.655**	.744**	-

Note. ^aMale = 0, Female = 1, * $p < .05$, ** $p < .01$, $N = 98$ -101

opportunities) between the three groups, $F_s \leq 1.96$, $p_s \geq .145$. Analyses testing for differences in demographics and PhD characteristics did not indicate any differences pertinent to the main analyses and are reported and elaborated on in the Supplemental Materials (See Section 3).

Analysis plan

Because we had specific a-priori expectations with regard to how groups should differ over time, we conducted a series of pairwise comparisons (Tabachnick & Fidell, 2001). Contrast coefficients for all hypothesized contrasts can be found in Table 4¹⁰. We first report the intervention effects for the PsyCap-only group on personal resources (H1a-b) and well-being outcomes (H2a-b). Next, we report the intervention effects for the self-compassion-based PsyCap group on personal resources (H3a-c) and well-being outcomes (H4a-c). Finally, we checked for differences in all outcomes from pre-intervention (T1) to post-intervention (T2) for the control group. Additionally, we report results from a set of Mixed-model ANOVAs which also test for time-by-group interaction effects. Means and standard deviations for the outcomes at pre-intervention (T1) and post-intervention (T2) for each group can be found in Table 3. Following our preregistration, we furthermore explored whether the effects of interventions on personal resources influenced subsequent well-being outcomes at follow-up (T3).

In an exploratory analysis¹¹ we examined if the increase in self-compassion at post-intervention (T2) as a result of the self-compassion-based PsyCap intervention led to a subsequent increase in psychological capital at follow-up (T3).

Main analyses

Effects of the PsyCap-Only intervention

Participants reported higher levels of psychological capital at post-intervention (T2) compared to pre-intervention (T1), $F(1, 38) = 5.81$, $p = .021$, $\eta_p^2 = .133$, 95% CI [0.026, 0.300]. Therefore, Hypothesis 1a was supported. There was no difference in psychological capital compared to the control group at post-intervention (T2), $F(1, 112) = 1.25$, $p = .266$, $\eta_p^2 = .011$, 95% CI [-0.125, 0.447]. Therefore, Hypothesis 1b was not supported.

With respect to well-being outcomes (Hypothesis 2a), we only found a decrease in work pressure, $F(1, 38) = 7.75$, $p = .008$, $\eta_p^2 = .169$, 95% CI [-0.477, -0.075] from pre-intervention (T1) to post-intervention (T2). There was no change in positive affect, $F(1, 38) = 1.57$, $p = .218$, $\eta_p^2 = .040$, 95% CI [-0.071, 0.302] and support seeking, $F(1, 38) = 0.84$, $p = .365$, $\eta_p^2 = .022$, 95% CI [-0.073, 0.195]. This partly supports Hypothesis 2a for one of the well-being outcomes (i.e., work pressure).

¹⁰ Contrast weights for exploratory analyses can be found in Table S10 in the Supplemental Materials (See Section 9).

¹¹ We also used exploratory analyses to test for the longevity of the intervention effects (i.e., differences between T1 and T3). These analyses are presented in the Supplemental Materials (See Section 5). We also conducted a repeated-measures ANOVA to examine changes in outcomes across all times and groups (See Section 7 and Figure S2 for a visual presentation of change in outcomes over time).

Table 3 Means and Standard Deviations for Outcome Variables at Pre- and Post-Intervention

Study variables		Control (<i>n</i> = 44)			PsyCap-Only (<i>n</i> = 39)			PsyCap + SC (<i>n</i> = 32)		
		<i>M</i>	<i>SD</i>	η_p^2	<i>M</i>	<i>SD</i>	η_p^2	<i>M</i>	<i>SD</i>	η_p^2
Psychological capital	T1	3.80 _a	0.61	.000	3.80_a	0.58	.133	3.95 _a	0.58	.054
	T2	3.80 _a	0.69		3.96_{ab}	0.59		4.11 _b	0.68	
Self-compassion	T1	2.90 _a	0.74	.004	2.79_a	0.74	.166	2.99_a	0.75	.187
	T2	2.94 _a	0.72		3.11_{ab}	0.68		3.39_b	0.66	
Positive affect	T1	3.00 _a	0.66	.075	2.83 _a	0.66	.040	3.09 _a	0.63	.114
	T2	2.83 _a	0.63		2.95 _a	0.62		3.35 _b	0.76	
Work pressure	T1	5.01 _a	0.98	.003	5.06_a	0.77	.169	4.87_a	0.95	.181
	T2	4.97 _a	0.95		4.78_{ab}	0.81		4.49_b	0.82	
Support seeking	T1	2.85 _a	0.50	.001	2.77 _a	0.67	.022	2.92_a	0.58	.430
	T2	2.87 _a	0.50		2.83 _a	0.61		3.23_b	0.59	

Note. *N* = 115. Significant contrasts (two-tailed, *p* < .05) testing the difference between T1 and T2 are indicated in bold. Effect sizes pertain to contrasts testing the difference between T1 and T2. Significant contrasts testing differences across conditions are indicated by different subscripts

At post-intervention (T2), there was no difference in positive affect, $F(1, 112) = 0.62, p = .432, \eta_p^2 = .006, 95\% \text{ CI} [-0.175, 0.405]$, work pressure, $F(1, 112) = 0.98, p = .325, \eta_p^2 = .009, 95\% \text{ CI} [-0.568, 0.190]$, or support seeking, $F(1, 112) = 0.10, p = .753, \eta_p^2 = .001, 95\% \text{ CI} [-0.285, 0.207]$ compared to the control group. Hypothesis 2b was not supported.

Unexpectedly, participants in the PsyCap-only intervention—that is PhD students who did not receive any training in self-compassion—reported higher levels of self-compassion

Table 4 Contrast Coefficients for the Multiple Contrast Tests Pertaining to Hypotheses H1-H4

NR	HYP	Dependent variable	Comparison	PsyCap-Only		PsyCap + SC		Control	
				T1	T2	T1	T2	T1	T2
Contrast coefficients									
1	H1a	Psychological capital	Within-group	-1	1	-	-	-	-
2	H1b		Between-groups	-	1	-	0	-	-1
3	H2a	<u>PA, WP, SS</u>	Within-group	-1	1	-	-	-	-
4	H2b		Between-groups	-	1	-	0	-	-1
5	H3a	<u>Psychological capital,</u>	Within-group	-	-	-1	1	-	-
6	H3b	<u>Self-compassion</u>	Between-groups	-	0	-	1	-	-1
7	H3c		Between-groups	-	-1	-	1	-	0
8	H4a	<u>PA, WP, SS</u>	Within-group	-	-	-1	1	-	-
9	H4b		Between-groups	-	0	-	1	-	-1
10	H4c		Between-groups	-	-1	-	1	-	0

Note. SC = self-compassion, NR = number of planned contrasts, HYP = hypothesis, PA = positive affect, WP = work pressure, SS = support seeking. Significant contrasts are bolded and/or underlined. For example, the self-compassion-based PsyCap group showed improvements in positive affect and support seeking but not work pressure compared to the PsyCap-only group (see comparison 10)

at post-intervention (T2) compared to pre-intervention (T1), $F(1, 38) = 7.55, p = .009, \eta_p^2 = .166, 95\% \text{ CI } [0.085, 0.564]$. This increase was not significantly different from the control group, $F(1, 112) = 1.28, p = .260, \eta_p^2 = .011, 95\% \text{ CI } [-0.129, 0.472]$.

While a Mixed-model ANOVA showed a significant time-by-group interaction effect on positive affect, post-hoc tests revealed that this effect was driven by a decrease in positive affect over time in the control group. There were no other time-by-group interaction effects, which is in line with our findings that the PsyCap-only group did not report higher personal resources or well-being compared to the control group. However, there was a marginal interaction effect such that the PsyCap-only group tended to report more psychological capital ($p = .078$) and self-compassion ($p = .058$) compared to the control group. Full results are reported in Table 5.

To sum up, psychological capital and, unexpectedly, self-compassion, increased compared to pre-intervention (T1) but not compared to the control group. The time-by-group interactions were not statistically significant. In terms of well-being outcomes, we found that work pressure decreased relative to pre-intervention (T1) levels but not compared to the control group. There was no evidence of a time-by-group interaction. There were no changes in positive affect or support seeking.

Effects of the self-compassion-based PsyCap intervention

Psychological capital did not increase from pre-intervention (T1) to post-intervention (T2), $F(1, 31) = 1.76, p = .194, \eta_p^2 = .054, 95\% \text{ CI } [-0.087, 0.411]$ but self-compassion did, $F(1, 31) = 7.14, p = .012, \eta_p^2 = .187, 95\% \text{ CI } [0.092, 0.689]$. Therefore, Hypothesis 3a was partly supported for self-compassion. At post-intervention (T2), psychological capital, $F(1, 112) = 4.09, p = .045, \eta_p^2 = .035, 95\% \text{ CI } [0.006, 0.611]$ and self-compassion, $F(1, 112) = 7.75, p = .006, \eta_p^2 = .065, 95\% \text{ CI } [0.129, 0.763]$ were also higher compared to the control group. Therefore, Hypothesis 3b was fully supported. Yet, they did not show higher levels of self-compassion, $F(1, 112) = 2.78, p = .098, \eta_p^2 = .024, 95\% \text{ CI } [-0.052, 0.600]$, or psychological capital, $F(1, 112) = 0.89, p = .349, \eta_p^2 = .008, 95\% \text{ CI } [-0.163, 0.457]$ compared to the PsyCap-only group. Therefore, Hypothesis 3c was not supported.

With respect to well-being, we found higher levels of support seeking, $F(1, 31) = 23.40, p < .001, \eta_p^2 = .430, 95\% \text{ CI } [0.176, 0.433]$ and lower levels of work pressure, $F(1, 31) = 6.91, p = .013, \eta_p^2 = .182, 95\% \text{ CI } [-0.679, -0.086]$ from pre-intervention (T1) to post-intervention (T2). There was no increase in positive affect, $F(1, 31) = 3.98, p = .055, \eta_p^2 = .114, 95\% \text{ CI } [-0.006, 0.527]$. Therefore, Hypothesis 4a was partly supported by showing changes over time in two well-being outcomes (i.e., work pressure and support seeking).

Compared to the control group, we found higher levels of positive affect, $F(1, 112) = 11.13, p = .001, \eta_p^2 = .090, 95\% \text{ CI } [0.209, 0.822]$ and support seeking, $F(1, 112) = 7.42, p = .007, \eta_p^2 = .062, 95\% \text{ CI } [0.097, 0.617]$ and lower levels of work pressure, $F(1, 112) = 5.75, p = .018, \eta_p^2 = .049, 95\% \text{ CI } [-0.884, -0.084]$ after the intervention (T2). Therefore, Hypothesis 4b was supported for all well-being outcomes.

Compared to the PsyCap-only group, we found higher levels of positive affect, $F(1, 112) = 6.36, p = .013, \eta_p^2 = .054, 95\% \text{ CI } [0.086, 0.715]$ and support seeking, $F(1, 112) = 8.67, p = .004, \eta_p^2 = .072, 95\% \text{ CI } [0.130, 0.663]$ at post-intervention (T2). There was no difference in work pressure, $F(1, 112) = 2.03, p = .157, \eta_p^2 = .018, 95\% \text{ CI } [-0.706, 0.116]$ at post-intervention (T2). Therefore, Hypothesis 4c was partly supported for two of the well-being outcomes (i.e., positive affect and support seeking).

Table 5 Results of Mixed-Model ANOVAs: (1) PsyCap-Only vs. Control Group and (2) Self-Compassion-Based vs. Control Group

Outcome	PSY			SC			PA			WP			SS		
	F	p	η_p^2	F	p	η_p^2	F	p	η_p^2	F	p	η_p^2	F	p	η_p^2
Between-subjects effects															
Group (PsyCap-Only vs. Control)	0.37	.546	.005	0.04	.84	.001	0.04	.851	.000	0.15	.697	.002	0.28	.596	.003
Within-subjects effects															
Time (T1 vs. T2)	2.92	.091	.035	5.90	.017	.068	0.14	.709	.002	4.35	.040	.051	0.62	.434	.008
Time × Group	3.19	.078	.038	3.69	.058	.044	4.82	.031	.056	2.48	.119	.030	0.20	.660	.002
Between-subjects effects															
Group (PsyCap + SC vs. Control)	2.80	.098	.036	3.49	.066	.045	5.01	.028	.063	2.51	.118	.033	3.47	.066	.045
Within-subjects effects															
Time (T1 vs. T2)	1.52	.221	.020	6.66	.012	.083	0.42	.520	.006	5.45	.022	.069	10.26	.002	.122
Time × Group	1.67	.201	.022	4.51	.037	.057	7.86	.006	.096	3.64	.060	.047	8.20	.005	.100

Note. $n = 39$ (PsyCap-only group), $n = 32$ (PsyCap + SC group), $n = 44$ (Control group). *PSY* = psychological capital, *SC* = self-compassion, *PA* = positive affect, *WP* = work pressure, *SS* = support seeking. Significant effects ($p < .05$) are in bold

Mixed-model ANOVAs showed significant time-by-group interaction effects such that the self-compassion-based PsyCap group reported higher self-compassion, positive affect, and support seeking after the intervention (T2) compared to the control group. There was also a marginal interaction effect such that the self-compassion-based PsyCap group tended to report less work pressure ($p = .060$) compared to the control group. Additionally, there was a significant time-by-group interaction such that the self-compassion-based PsyCap group reported higher support seeking compared to the PsyCap-only group. Full results can be found in Table 5.

In sum, we found an increase in self-compassion relative to pre-intervention (T1) and control group. Psychological capital increased compared to the control group but not compared to pre-intervention (T1). In terms of well-being outcomes, we found that, after the intervention (T2), work pressure was lower compared to both pre-intervention (T1) and the control group. Also, participants reported higher levels of support seeking compared to pre-intervention (T1), the control group, and the PsyCap-only group. Finally, levels of positive affect were higher compared to the control group but not compared to pre-intervention (T1). In line with these findings, time-by-group interaction effects were found on self-compassion, positive affect, and support seeking in favor of the self-compassion-based PsyCap group (compared to the control group). Furthermore, a time-by-group interaction indicated an increase in support seeking compared to the PsyCap-only group.

Wait-List control group

As a comparison, we additionally checked whether participants in the control group reported any changes to either their personal resources or the well-being outcomes over time. There were no changes in psychological capital or self-compassion from pre-intervention (T1) to post-intervention (T2), $F_s \leq 0.16$, $p_s \geq .688$ nor in any of the well-being outcomes, $F_s \leq 3.50$, $p_s \geq .068$.¹² Full results can be found in Table S5 (see Section 6 in the Supplemental Materials).

Mediation effects of personal resources

In line with our theorizing that participating in the interventions increases personal resources (i.e., PsyCap and self-compassion), which, in turn, improve well-being, we examined whether the interventions had an indirect effect on well-being outcomes via personal resources. Importantly, given that psychological capital increased after the PsyCap-only intervention but not after the self-compassion-based PsyCap intervention, we only tested for an indirect effect via psychological capital in the PsyCap-only group. We also tested for an indirect effect via self-compassion in the PsyCap-only group given that self-compassion, unexpectedly, increased after the intervention (T2). In the self-compassion-based PsyCap group, we only tested for an indirect effect via self-compassion. To examine whether an increase in personal resource after intervention (T2) increased well-being outcomes at follow-up (T3), we ran a mediation model in which the interventions (dummy-coded with the control group as the reference category) served as a predictor, the personal resource at post-intervention (T2) as mediator, and the respective well-being outcome at follow-up (T3) as outcome. The mediator (i.e., psychological capital or self-compassion)

¹² The marginal significant effect pertained to a decrease in positive affect from pre-intervention to post-intervention.

and the well-being outcome at pre-intervention (T1) were included as covariates in the model (Valente & MacKinnon, 2017). We used PROCESS model 4 in SPSS (Hayes, 2012) to conduct these analyses. The results showed that the self-compassion-based PsyCap intervention had a significant indirect effect on all three well-being outcomes via self-compassion. More specifically, the self-compassion-based PsyCap intervention (when compared to the control group) had a positive effect on self-compassion at post-intervention (T2), which, in turn, led to increases in positive affect and support seeking, and reductions in work pressure at follow-up (T3). In contrast, the PsyCap-only intervention (when compared to the control group) did not show any indirect effects on well-being outcomes through either psychological capital or self-compassion. Together, these results suggest that increases in self-compassion led to subsequent changes in well-being and that this was only true for the self-compassion-based PsyCap intervention. See Table 6 for the direct and indirect effects and Fig. 2 for a graphical representation of the significant indirect effects.

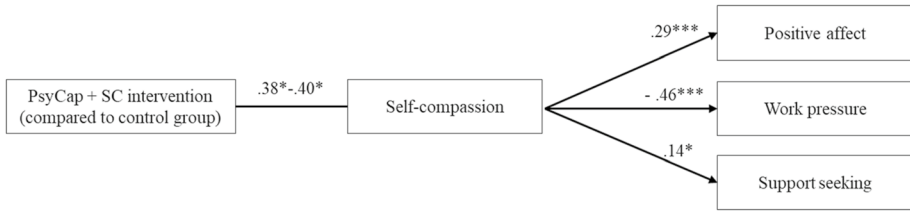
Exploratory analysis

In line with our argument that self-compassion helps to build psychological capital, we additionally explored whether this process may be delayed and unfold over a longer time. Thus, we tested if the self-compassion-based PsyCap intervention (compared to the control group) led to an increase in self-compassion at post-intervention (T2) which, in turn, led to an increase in psychological capital at follow-up (T3). Again, we controlled for the mediator (i.e., self-compassion) and outcome (i.e., psychological capital) at pre-intervention (T1) by including them as covariates in the model. The results showed a significant indirect effect of the self-compassion-based PsyCap intervention on psychological capital at follow-up (T3) via self-compassion at post-intervention (T2), supporting our idea that

Table 6 Direct and Indirect Effects of Interventions on Well-Being via (a) Self-Compassion and (b) Psychological Capital

a)	Outcomes at T3		
	Positive affect	Work pressure	Support seeking
Direct effects			
PsyCap-only intervention	0.05(-0.17; 0.27)	-0.10 (-0.45; 0.26)	-0.11 (-0.29; 0.07)
PsyCap + SC intervention	0.06 (-0.17; 0.30)	-0.24 (-0.63; 0.14)	0.17 (-0.03; 0.36)
Indirect effects			
PsyCap-only intervention → Self-compassion T2 → Outcome T3	0.07 (-0.01; 0.16)	-0.11 (-0.27; 0.02)	0.04 (-0.004; 0.11)
PsyCap + SC intervention → Self-compassion T2 → Outcome T3	0.11 (0.02; 0.22)	-0.19 (-0.40; -0.03)	0.06 (0.01; 0.14)
b)	Outcomes at T3		
	Positive affect	Work pressure	Support seeking
Direct effects			
PsyCap-only intervention	0.09(-0.14; 0.32)	-0.15 (-0.51; 0.21)	-0.09 (-0.27; 0.09)
Indirect effect			
PsyCap-only intervention → PsyCap T2 → Outcome T3	0.04 (-0.02; 0.12)	-0.06 (-0.20; 0.04)	0.04 (-0.01; 0.06)

Note. PsyCap + SC intervention = self-compassion-based PsyCap intervention. The 95% confidence intervals are reported in parentheses. Results are based on 5000 bootstrap samples. Significant effects ($p < .05$) are highlighted in bold



Note. For every outcome measure a separate model was tested, which is why the a-path slightly varies depending on which outcome variable was being controlled for at T1. The effect of the Self-compassion-based PsyCap intervention entails a comparison of the self-compassion-based PsyCap group and the control group. The mediator and outcome variable at T1 were controlled for. SC = Self-compassion.

Fig. 2 Indirect Effects of the Self-compassion-based PsyCap Intervention on Changes in Positive Affect, Work Pressure, and Support Seeking (T3) via Increase in Self-Compassion (T2)

self-compassion benefits PsyCap development. Given that we did not find an effect of our self-compassion-based PsyCap intervention on psychological capital at post-intervention (T2), we did not test the reverse indirect effect model in which psychological capital at post-intervention (T2) serves as the mediator and self-compassion at follow-up (T3) as the outcome (Table 7).

Table 7 Means and Standard Deviations for Outcome Variables at all Three Timepoints

Study variables		Control (n = 35)			PsyCap-only (n = 37)			PsyCap + SC (n = 28-29)		
		M	SD	η_p^2	M	SD	η_p^2	M	SD	η_p^2
Psychological capital	T1	3.85 _a	0.56	.026	3.81_a	0.59	.141	3.94 _a	0.60	.078
	T2	3.87 _a	0.64		3.96 _a	0.57		4.19 _a	0.64	
	T3	3.92 _a	0.64		4.01_a	0.60		4.13 _a	0.69	
Self-compassion	T1	2.90 _a	0.78	.023	2.80_a	0.76	.152	3.03 _a	0.75	.088
	T2	2.92 _a	0.73		3.11 _{ab}	0.70		3.38 _b	0.67	
	T3	3.01 _a	0.77		3.12_a	0.64		3.27 _a	0.85	
Positive affect	T1	2.94 _a	0.66	.015	2.84_a	0.67	.173	3.09 _a	0.66	.077
	T2	2.87 _a	0.56		2.96 _a	0.63		3.39 _b	0.78	
	T3	3.01 _a	0.64		3.09_a	0.64		3.26 _a	0.59	
Work pressure	T1	4.96 _a	0.96	.048	5.06_a	0.77	.224	4.87_a	0.93	.309
	T2	4.92 _a	0.92		4.82 _a	0.81		4.47 _b	0.84	
	T3	4.76 _a	0.91		4.61_{ab}	0.82		4.29_b	1.06	
Support seeking	T1	2.85 _a	0.48	.014	2.74 _a	0.67	.005	2.94_a	0.60	.233
	T2	2.89 _a	0.40		2.78 _a	0.58		3.18 _b	0.59	
	T3	2.91 _a	0.40		2.77 _a	0.58		3.18_b	0.51	

Note. N = 100-101. Significant contrasts ($p < .05$) testing the difference between T1 and T3 variables within a condition are indicated in bold. Effect sizes pertain to contrasts testing the difference between T1 and T3 (see also Table S2, S3, and S6 in the Supplemental Materials). Different subscripts within rows indicate significant pairwise comparisons between conditions on those variables. In the self-compassion-based PsyCap group (PsyCap + SC), one participant did not complete the self-compassion measure at T3. Therefore, we calculated differences in self-compassion (and psychological capital) between T1 and T3 based on 28 participants. For all other outcomes, the analyses were based on 29 participants. The means in Table 7 differ from the means reported in Table 3 due to the smaller sample that participated in all three time points

For comprehensiveness, we also checked whether the PsyCap-only intervention led to a delayed increase in one resource (i.e., psychological capital or self-compassion) via increase in the other resource. There was no indirect effect of the PsyCap-only intervention (when compared to the control group) on psychological capital at follow-up (T3) via self-compassion at post-intervention (T2). Likewise, there was no indirect effect of the PsyCap-only intervention (when compared to the control group) on self-compassion at follow-up (T3) via psychological capital at post-intervention (T2). Together, these results suggest that only the self-compassion-based PsyCap intervention led to an increase in self-compassion which resulted in a subsequent increase in psychological capital. Full results are reported in Table S7 (see Section 8 in the Supplemental Materials).

Discussion

PhD students' well-being is critical for their functioning at work, yet, effective interventions to support PhD students are limited. Therefore, we designed two training interventions aimed at improving PhD students' well-being. With PhD students' cognitive (e.g., publication pressure) and emotional (e.g., insecurities) demands in mind, we designed one intervention that focused on the development of psychological capital (PsyCap) and a second intervention that expanded the first intervention with self-compassion practice. By comparing the effectiveness of two interventions, we show that the combination of developing self-compassion alongside PsyCap was more beneficial for PhD students' well-being than developing PsyCap alone. While participants in the PsyCap-only group reported a reduction in work pressure—there were no changes in positive affect or support seeking—participants in the self-compassion-based PsyCap group reported a reduction in work pressure, as well as higher levels of support seeking. Furthermore, we extend on previous intervention studies (Barry et al., 2019; Marais et al., 2018) by showing that both interventions not only enhanced PhD students' well-being, but also increased personal resources (i.e., PsyCap and self-compassion), either in the short-term or over a longer time period. Specifically, in the PsyCap-only intervention PsyCap and, unexpectedly, self-compassion, increased directly after the intervention. In the self-compassion-based PsyCap group, self-compassion increased directly after the intervention and led to an increase in PsyCap at follow-up. The follow-up measurement also allowed us to examine the process(es) through which the interventions led to improvements in PhD students' well-being over time. Specifically, using mediation analyses, we show that an increase in self-compassion, but not PsyCap, drove positive well-being changes after the self-compassion-based PsyCap intervention.

Below, we discuss the main findings in the context of the Conservation of Resources (COR) Theory and highlight theoretical and practical implications for the field of higher education.

Theoretical implications

Our study makes several contributions. By designing a PsyCap and a self-compassion-based PsyCap intervention and testing their effects on well-being using a randomized controlled design, we provided a robust test for the COR proposition that developing personal resources is beneficial for (higher-order) resources, such as well-being outcomes. Our

results generally confirm that training personal resources can promote various well-being outcomes, and as such speak to the role of personal resources as underlying mechanism explaining the well-being effects of such interventions. We want to discuss three interesting findings in this respect.

First, although PsyCap increased after the PsyCap-only intervention, it did not lead to improved subsequent well-being. While this was unexpected, it is possible that other unmeasured aspects of the intervention drove the observed reduction in perceived work pressure. Given that participants in the PsyCap-only intervention were encouraged to set achievable goals and make changes to their planning in order to meet their demands, job crafting behaviors, such as decreasing work demands, might be a potential mechanism to consider in future research. It will also be useful to complement effect evaluation with process evaluation data about how interventions were planned and implemented. Such data can inform researchers about “processes that facilitated the change” (Cooper et al., 2001) and can rule out that other factors than the intervention account for the (lack of) observed effects (Lipsey, 1996).

Second, although the PsyCap-only intervention was not explicitly concerned with the development of self-compassion, self-compassion increased after the intervention. Yet, this increase in self-compassion, which may have resulted from participants encouraging each other and realizing they are not alone in their concerns, did not drive any well-being effects in the PsyCap-only group. This finding is particularly interesting in comparison to the findings in the self-compassion-based PsyCap intervention, where the increase in self-compassion *did* drive changes in all three well-being outcomes. We see the following explanation: In line with COR theory arguing that resources hold value to the extent that they are perceived to help achieve goals (Halbesleben et al., 2014), it is possible that participants in the PsyCap-only intervention were not aware of and did not know how to capitalize on self-compassion as a resource. In other words, only if I recognize and understand that self-compassion can help me boost my well-being, and I know how to utilize self-compassion for that purpose, self-compassion will be beneficial. Following that logic, this may also explain why self-compassion only boosted PsyCap in the self-compassion-based PsyCap group—where participants learned how to use their self-compassion for the development and use of PsyCap—but not in the PsyCap-only group.

Finally, PsyCap did not increase immediately after the self-compassion-based PsyCap intervention but improved over a longer period of time via self-compassion. These findings generally support the idea that self-compassion can act as a key resource and boost other resources, as theorized. Because through self-compassion, people are encouraged to pay attention to self-care first when difficulties arise, rather than focus on goal achievement (e.g., the core of PsyCap) exclusively, PsyCap would not develop immediately after the self-compassion-based PsyCap intervention, but only over a longer period of time. Consequently, it may also take longer for PsyCap to translate into changes in well-being outcomes when trained alongside self-compassion. To examine if PsyCap, when trained alongside self-compassion, promotes well-being outcomes over time, future research should consider longer intervention timeframes with additional follow-up measurements.

Strengths, limitations, and future directions

This study has several strengths. First, the use of a wait-list randomized controlled trial design is an important strength of this study as it allows for directional claims that providing PhD students with PsyCap training and self-compassion-based PsyCap training led

to positive effects. Second, our design allowed for a comparison of two active intervention groups, making it possible to not only determine if these interventions were effective but we could also compare their effectiveness. Third, through the inclusion of a follow-up measurement three months after the interventions, we were able to test if our theoretical assumption that personal resources can explain improvements in well-being holds. Finally, we consider it a strength of our study that we designed an intervention that was tailored to PhD students' needs. Specifically, by focusing on PsyCap and self-compassion, we aimed to provide PhD students with both cognitive and emotional support strategies. Since we found that the beneficial effects of the self-compassion-based PsyCap intervention on well-being operated through self-compassion, we suggest that emotional support, in particular, appears to be an important strategy to improve PhD students' well-being in a timely manner.

Our study also has some limitations that should be mentioned. First, due to practical constraints, the number of participants varied across groups—with smaller number of participants in both intervention groups—potentially impacting power (Rusticus & Lovato, 2014). Indeed, a sensitivity analysis showed that medium-to-large effect sizes were required to detect differences between the intervention groups and the control group. While, overall, intervention effects were sufficiently large in the self-compassion-based PsyCap group, effects were smaller in the PsyCap-only intervention, and as such could not always be detected. In order to be able to also detect small effects, which are common for positive psychology interventions (Donaldson et al., 2019), we recommend to aim for larger sample sizes in the future. At the same time, however, the total sample in our study was substantially larger compared to previous intervention studies (e.g., Barry et al., 2019; Marais et al., 2018). Second, our interventions were limited to a single workshop and subsequent homework practice. The lack of guidance after the initial workshop, particularly during the homework practice, might have lessened the effectiveness of the interventions. To address this limitation, future studies could integrate a “booster session” after the intervention in order to increase the training transfer (e.g., Beauchamp et al., 2011). Third, for reasons of comparability, the length of the interventions including the duration of the workshop was similar. Yet, because the PsyCap-only intervention included content on PsyCap only, whereas the self-compassion-based PsyCap intervention included content on both PsyCap and self-compassion, it is possible that the self-compassion content detracted from PsyCap, such that participants in the self-compassion-based PsyCap intervention spend less time engaging with PsyCap compared to participants in the PsyCap-only intervention. However, given that the self-compassion-based PsyCap group reported an increase in PsyCap at follow-up, via self-compassion at T2, it seems that self-compassion did not detract from building PsyCap after all but instead helped to develop PsyCap over time. Generally, intervention designers should make sure to provide participants with sufficient time to build multiple resources. Fourth, given the tailored design of our interventions, it is unclear to what extent findings generalize to other higher education professionals. However, given that most PhD students in our study were employed and worked full-time, we believe that our findings can extrapolate to other higher education professionals, especially those with comparable high-strain job characteristics. Future research should examine whether the intervention effects hold in other professional (and student) groups and contexts as well. For example, PhD students in other (including non-WEIRD) countries might need additional or other support strategies beyond PsyCap and self-compassion. Finally, participants self-selected to participate in our study. This means that we potentially only sampled those who had sufficient resources (e.g., time and personal energy) to join the training but not necessarily those who needed it the most, such as PhD students who faced extreme workloads or mental health issues. Given that those who need an intervention more are more

likely to benefit from it (Baldwin & Ford, 1988), the intervention effects might be a conservative estimate of the effectiveness of the intervention. Future research could conduct a needs assessment prior to the intervention in order to identify and potentially control for or include the need for the intervention as a moderator in the analysis (see e.g., Homan et al., 2015). Future studies should also seek ways to ensure that all PhD students, also those with relatively low resources, sign up and participate in training interventions. To realize this, a fruitful approach could be to make such interventions and training programs an integral part of PhD students' curriculum.

Practical implications

Our study has noteworthy practical implications. Our study shows that brief online interventions focused on PsyCap and self-compassion-based PsyCap can have a positive impact (albeit to a different extent) on PhD students' functioning. Specifically, the PsyCap-only intervention had a positive effect on increasing PsyCap and self-compassion and reducing work pressure, while the self-compassion-based PsyCap intervention increased self-compassion and had a positive effect on well-being in terms of reducing work pressure and increasing support seeking behavior. Given that the self-compassion-based PsyCap intervention had a bigger impact on well-being, we recommend the self-compassion-based PsyCap intervention in particular as a practical tool to support PhD students. While our findings show that developing individual resources is beneficial for PhD students' well-being, we also want to encourage practitioners to take into account the larger context. Specifically, in the case of self-compassion-based interventions, practitioners should consider that PhD students' self-criticism and lack of self-compassion is a natural response to the high-pressure academic work environment. Hence, we suggest that PhD students may face structural barriers to cultivating their self-compassion. While our findings suggest that training interventions (i.e., self-compassion-based PsyCap intervention) can help break down these barriers to some degree, they do not eliminate the root cause of the problem. To tackle these underlying issues, university management should adopt a multilevel approach (De Angelis et al., 2020) to PhD student well-being, that is to offer interventions that increase PhD students' individual-level resources (e.g., self-compassion) while at the same time implementing change initiatives also at the group (i.e., colleagues), leader (i.e., supervisors) and organizational level (i.e., policies). With regard to interventions at the group level, initiatives recognizing and rewarding communal (e.g., being kind and concerned for others) rather than only agentic (e.g., being independent and competitive) characteristics could be a fruitful approach to change academia's narrowly defined standard of success and to foster a more supportive academic culture (Van Veelen & Derks, 2022). At the leader level, it could be beneficial to start a conversation about what is needed from supervisors in order for PhD students to develop self-compassion and to maintain their well-being. Finally, at the organizational level, universities could consider altering their publication requirements for PhD students in order to reduce some of the pressures that PhD students currently experience.

Conclusion

In this study, we compared the effectiveness of a PsyCap-only intervention and a self-compassion-based PsyCap intervention in fostering PhD students' well-being. We show that complementing a PsyCap intervention with self-compassion was more beneficial

for PhD students' well-being than a PsyCap intervention alone. Moreover, an increase in self-compassion led to subsequent improvements in well-being over time. Given that these effects operated through changes in self-compassion rather than PsyCap, we conclude that treating yourself like a close friend (i.e., self-compassion) and developing the HERO within (i.e., PsyCap) has benefits for PhD students over and above only developing the HERO within. Taken together, our study provides theoretical and practical grounds to implement resource-enhancing interventions to boost well-being in the context of PhD education, and beyond.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s10734-024-01257-3>.

Code availability The Supplemental Materials and analysis code are available on the Open Science Framework at https://osf.io/7498j/?view_only=92403f28d1f44e3fbf423f02db59f01a and intervention materials are available upon request from the authors.

Author's contribution Luisa Solms, Machteld van den Heuvel, and Astrid Homan contributed to the study conception, design and material preparation. Luisa Solms and Machteld van den Heuvel performed the data collection. Analyses were performed by Luisa Solms and Barbara Nevicka. The first draft of the manuscript was written by Luisa Solms and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Data availability The data on which the study is based are not publicly available due to its sensitive nature, but will be available in anonymized form from the corresponding author upon reasonable request.

Declarations

Ethics approval Data have been collected in accordance with the University of Amsterdam Institutional Review Board (IRB; Ethics Committee FMG, 2021-WOP-13314) and the APA ethical standards.

Conflict of interest The second author received a fee for delivering the training sessions.

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