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Assessing the efficacy of a resilience training intervention for long-term improvements in well-being and resilience

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Abstract

This article has two aims: (1) to assess the impacts of a novel training intervention for individual well-being and (2) to measure the trajectory of resilience over the training period dependent on reported significant life events. Using a randomised controlled trial with a diverse German sample with the majority drawn from a student population, we measure the effects of the intervention to provide insight into its impacts and act as a proof of concept for the training. We find that the training intervention boosts resilience and other related well-being measures with a high effect size in comparison with a control group and compared with existing resilience training studies.

KEYWORDS

education, mental health, personality trait changes, resilience, subjective well-being, training intervention

INTRODUCTION

Being able to withstand difficult life events and maintain or recover quickly our normal functioning is an important factor in sustained psychological well-being. Research on this has increased substantially in recent decades, and its importance has been made even clearer since the COVID-19 global pandemic, the effects of which on mental health are starting to be observed. Public health policy responses such as lockdowns may in particular have taken a toll on mental health, and research shows increases in depression and anxiety symptoms recorded

in several countries (Fullana et al., 2020; Ivbijaro et al., 2020). The importance, therefore, of being able to sustain healthy psychological functioning in the face of adversity is all the more obvious, as recent times have led to more testing conditions for most of us.

The present study reports the outcome of a novel training intervention to increase long-term, psychological resilience and improve well-being outcomes, with a follow up of 1 month to examine if changes to well-being outcomes are sustained after the training has ceased. In addition, we seek to examine the impact of acute life events on measured resilience and the effects of training. An exploratory model of resilience is presented for our sample, showing influencing factors of resilience and their relationship to well-being outcomes such as anxiety, depression, life satisfaction, and experience of physical symptoms (somatisation), outcomes which have all been previously linked to resilience.

Resilience definitions

Resilience is a much-debated concept that remains without a single agreed definition. On the one hand, it has been argued as a process and outcome of adaptational behaviour to circumstances and life events (American Psychological Association, n.d.). On the other hand, scholars have defined resilience as a trait-like construct that is fairly stable over time (Block & Kremen, 1996; Letzring et al., 2005). Recent work including, for example, that by Masten (2014, 2019) has defined resilience from a systems perspective as the capacity of a system to adapt successfully to disturbances that threaten its viability, function, or development. The definition can be applied to different systems and at different levels including individuals, households, communities, organisations, the economy, or ecosystem. We draw on these contributions to define resilience at the individual level as the relatively stable capacity to demonstrate successful adaptation, recovery, and strength from experiences of social disadvantage, adversity, or change (Chmitorz et al., 2018; Kleim & Kalisch, 2018; Noble & McGrath, 2012).

Resilience stability

If we see resilience as a multifaceted construct influenced by a number of factors, some of these factors may be more malleable to change than others. Roberts et al. (2017) show in a meta-analysis with 207 included studies that personality traits can be changed within a few months through therapies or interventions, especially in the areas of extraversion and neuroticism and these changes can be lasting. Other trait-like characteristics may change over the life course. Openness to experience and extraversion seem to decrease slowly over the lifespan, while other personality traits such as agreeableness (i.e. empathy and cooperativeness) seem to increase on average with age (Lucas & Donnellan, 2011). The malleability of even some trait-like constructs gives impetus to training interventions to increase resilience, because resilience consists of and is influenced by various traits like self-efficacy, self-esteem, locus of control, and others outlined in the next section (Bengel & Lyssenko, 2012; Kunzler et al., 2020). Similarly, feelings of satisfaction and increased self-worth can be enhanced by psychotherapies (Dick, 2007; Oei & McAlinden, 2014).

Resilience is impacted by life events and environmental factors as well (Bonano, 2005; Southwick et al., 2014). For example, though certain individuals may be more prone to depression, it can be triggered by the death of family members or feeling overwhelmed due to the birth of a

child (Daley et al., 2009; Treloar et al., 1999). Some evidence shows that life events can permanently affect well-being, such as widowhood or divorce, and that these have negative and long-lasting influences on life satisfaction with previous levels never recovered (Diener & Seligman, 2004). In a meta-analysis, Luhmann et al. (2012) show that life satisfaction is permanently reduced by unemployment lasting for several years even when re-entering the labour market. Macro events such as economic shocks can also impact long-term mental health (Drydakis, 2015). It stands to reason that recent traumatic life events would impact upon short-term resilience as measured by resilience scales. Our study examines this by the trajectories of resilience over, and in the period after, training for those experiencing recent impactful life events.

Resilience influencing factors

The existing evidence base highlights several factors that appear to influence relative levels of resilience, and it is useful to note that this body of research is not guided by any overarching single conceptual framework or model. Bengel and Lyssenko (2012) reviewed empirical findings showing consistent correlations between measured resilience and a large number of factors comprising positive emotions, optimism, hope, self-efficacy, self-esteem, locus of control, sense of coherence, hardiness, religiosity and spirituality, coping, and social support. Helmreich et al. (2017) identified several resilience factors commonly used in training interventions including active coping, self-efficacy, optimism, social support, cognitive flexibility (including acceptance and reappraisal), religiosity, spirituality, and religious coping. They identified positive emotions, hardiness, self-esteem, meaning in life, and sense of coherence as key resilience factors with strong support, with moderate evidence for locus of control, coping flexibility, hope, and humour. Masten (2019), meanwhile, summarises common factors to comprise self-efficacy, optimism, supportive relationships and effective caregiving, problem-solving and self-regulation skills, and belief in the meaningfulness of life. Additional factors, including spiritual and ritualistic behaviours, are argued as more unique to specific cultures or contexts. Existing research, as such, identifies a large number of psychological factors implicated in resilience, though there is scant solid and consistent evidence to advance a predictive model due to a multiplicity of definitions, designs, and outcome measures used and methodological and sample size differences (Kunzler et al., 2020). This renders creating a model of resilience difficult based on the disparate and low certainty evidence available and generates a need for more research to model resilience factors. Some scholars have presented conceptual models of resilience that take a narrower set of factors. Iacoviello and Charney (2014) categorise factors as cognitive (e.g. flexibility and active coping skills), behavioural (e.g. physical activity and seeking help), and existential (e.g. spirituality and meaningfulness). Haglund et al. (2007) focus on the psychoneurobiological factors related to the processing of threat, stress, and fear responses. As such, resilience is an umbrella term for various trait-like constructs, which are mostly stable but which evidence suggests has the potential to be changed by interventions.

Resilience interventions and impacts on well-being

Resilience has central relevance to, and is a coping component of, well-being (Noble & McGrath, 2012). A systematic review of 19 studies found evidence that resilience interventions can be helpful in times of distress caused by the negative event of a highly contagious disease

outbreak (Kunzler et al., 2020). For example, a study with 23,192 participants from China conducted at the end of March 2020 revealed that, especially during a stress-evoking time such as the pandemic, resilience capabilities are a positive predictor of mental health (Li et al., 2021). As such, resilience is increasingly relevant in individual, organisational, and educational contexts, and there is a growing need for understanding of how to build and maintain resilience.

Developing an understanding of, and modelling, the key influencing factors in resilience has been taken forward through existing studies which have drawn on diverse populations including those that have assessed the impacts of intervention trials aiming to promote resilience (Masten, 2019). Most previous training interventions have been based on cognitive behaviour therapy or mindfulness approaches (Liu et al., 2020). A meta-review by Vanhove et al. (2015) revealed common exercises focussed on aspects such as self-efficacy, optimism, social resources, or cognitive appraisal. Another systematic review by Kunzler et al. (2020) lists exercises including reflecting on meaningfulness, relationships, personal and external resources, mindfulness techniques, optimism, self-acceptance, and active coping. A recent review by Kaye-Kauderer et al. (2021) notes a lack of consistency in resilience interventions including format, method of delivery, and outcome measures. However, despite these variations, the review of 44 randomised controlled trials (RCTs) indicated improvements in resilience and mental health evident 3 months following the training intervention.

Existing studies have shown that resilience training can provide several well-being benefits (Cantarella et al., 2017). Chesak et al. (2019), for example, test a novel resilience intervention aiming to enhance well-being among a sample of 55 public school teachers in the United States. They identified positive impacts from the training programme on several measures of well-being comprising stress, anxiety, resilience, gratitude, happiness, life satisfaction, and quality of life. Liu et al.'s (2020) meta-analysis of resilience interventions included a total of 268 studies, with 1584 independent samples. Resilience-promoting interventions yielded a small, but statistically significant overall effect with significant variability in effect sizes between studies and many fell short of criteria for practical significance. The authors note problems with the lack of agreement on conceptualisation and operationalisation of resilience. Perhaps, it is not surprising that the effects of mindfulness-based approaches and Cognitive behavioral therapy (CBT), which formed the majority of interventions, will be mixed if we see resilience conceptually as multifactorial. Arguably, more comprehensive training packages are required that reflect a multifaceted conceptual model.

Existing studies identify positive effects from training and highlight the importance of developing tailored and comprehensive approaches. That said, there remain significant gaps in understanding of the centrality of different factors in resilience, namely, the lack of conceptual or statistical models of resilience and its influencing factors and of the efficacy of training interventions for resilience and individual well-being. We therefore apply a resilience boosting training intervention that addresses resilience and provides exercises that cover a more comprehensive range of factors, such as self-esteem, coping skills, dealing with rumination, developing social support, and encouraging healthy physical practices among others. This goes beyond many previous narrower approaches that have been grounded in mindfulness or CBT.

Aims of the study

In this study, we present the findings from an RCT of a novel resilience training intervention which was used to test the effects of the intervention providing insight into its impacts and

acting as a proof of concept for the resilience training intervention aimed at providing self-sustaining strategies for long-term resilience. We map the trajectories of resilience and examine the effects of resilience training on people who have experienced recent significant life events. The study has two central objectives/aims.

The first objective is to test whether it is possible to increase resilience levels long-term through a novel training intervention, measuring the effects in a 1 month post-training follow-up, with pre-, post-, and follow-up time measurement points and comparison with a control group. It is anticipated that the training will have potential for long-term efficacy as it aims to encourage self-sustained strategies for long-term resilience. The training intervention contains known resilience exercises from the literature including self-assessments of optimism, writing about one's best self, setting goals, a brief meditation exercise, a list of positive emotional activities, or how to stop rumination but also novel exercises like discussions on how to deal with social conflicts, self-reflection on self-worth, and guided meditations for mindset and attitude changes. Our training intervention is novel both through its comprehensiveness and focus on a broad range of techniques that can be learned and self-sustaining over time and conceptually influenced by the idea that resilience is multifaceted. We compare the effect sizes found in our study with previous published resilience interventions to give an indication of how this intervention compares with previous ones.

Adaptation to stressful or traumatic life events is one of the hallmarks of resilience. The second objective therefore addresses the question of whether the trajectory of resilience over the training period is dependent on reported significant recent life events, in particular, to examine if training is more or less efficacious depending upon recent significant life events. We would expect to see that resilience levels would be lower (albeit temporarily perhaps) in those experiencing a recent negative life event compared with those experiencing no significant event or a positive event. According to accepted definitions of resilience, levels should be fairly stable and show a "bounce back" effect after a negative life event—although we argue that resilience level itself can be affected by training programmes. It may be that the training intervention has a differential effect depending upon recent life events and we should expect that an efficacious training would have greater effects on those whose resilience level is currently affected by a negative life event, as there is more scope for recovery and a ceiling for those with already high resilience functioning.

METHOD

Study description and research design

The present study consisted of a pre-post-test RCT design which is the so-called "gold standard" for analysing intervention efficacy (Nezu & Nezu, 2008). A training group was compared with a control group that did not receive the training. Online training was delivered via Zoom video conferencing sessions. The training consisted of three virtual workshop sessions taking place over 3 weeks, that is, one session per week with a length of 3.5 h each (10.5 h total). Due to practicality around participant availability as well as to ensure that participants were able to engage fully in the content, the training was distributed over five cohorts of 20–30 persons in each. Three measurement time points were given, one before the study began (directly combined with the registration form), one at the end of session 3 right after the training, and one to measure the sustainability of the training impacts 1 month after the training of each cohort ended.

Participants

The sample consisted of a combination of German university students and working participants recruited through email advertisements at different universities and through social media communications including Facebook and LinkedIn groups and self-help groups, hence a mixed sample. All participants volunteered to take part in the study (inclusion criteria). The only exclusion criterion was having a mental disorder. In total, 229 participants registered for the training intervention and filled out a pre-training questionnaire. The sample consisted of 20 in the control group ($M_{age} = 29.90$), and from the remaining initial sample, 140 attended session 1 of the training intervention ($M_{age} = 29.2$). At the end of the three sessions, a total of 96 persons had completed the whole training intervention. Finally, a follow-up online survey was administered 1 month later generating 85 responses. Several reasons were given for not completing all of the training sessions, including "second COVID-19 vaccination and having fever and chills," "having internet problems," and "cannot participate due to health reasons." Among the intervention sample, 82% were female, while the control group was 75% female. Approximately two thirds of participants were students (67% training group [IG] and 65% control group [CG]), with the remainder predominantly full-time employees (13% IG and 25% CG), part-time employees (8% IG and 5% CG), and self-employed (5% IG and CG). In terms of highest educational level, the profile of participants was varied with the majority having a high school diploma (54% IG and 55% CG) and with others reporting a bachelor degree (20% IG and CG) or master's degree (14% IG and 10% CG) and the remainder other qualifications from apprenticeships to PhDs.

Figure 1 summarises the group *n* and dropouts at each stage of testing. Typical dropout rates in the resilience training literature are on average 30% (Arnetz et al., 2009; Pidgeon et al., 2014) and tend to be higher in online training (Abbott et al., 2009). In our intervention over the duration of 3 weeks, a dropout rate of 32% was measured (96 of 140 participants that attended the first session finished the whole training), which is consistent with those reported in the existing literature. For robustness, an attrition analysis was conducted to consider the characteristics of the participants who completed the training ($n = 85$) against those who dropped out ($n = 124$) and those in the control group ($n = 20$). Overall, the comparison of participants who completed the training ($n = 85$) with those who did not does not uncover any specific concerns, with the only statistically significant difference being the mean age where we note a marginally lower average age among the training sample compared with the dropouts and control group (see Table 1). The analysis also confirms the control group offers a good degree of consistency in their characteristics to the group who completed the training. For additional robustness, binomial logistic regression and multinomial logistic regression models tested the group who completed the training against those who did not and those two groups against the control group. These analyses were performed comparing those who completed all of the training and surveys ($n = 85$) with those who registered ($n = 229$) and separately against those who had attended only the initial stage of the training ($n = 140$). These analyses generated no statistically significant results, with the exception of differences in economic status when comparing those who completed all elements of the training ($n = 85$) against those who registered ($n = 209$) and the control group ($n = 20$). Results are available upon request.

Procedure and intervention programme

In intervention studies where there are resource limitations, it is accepted to recruit a larger intervention group sample (Torgerson & Torgerson, 2008). Therefore, participants who signed

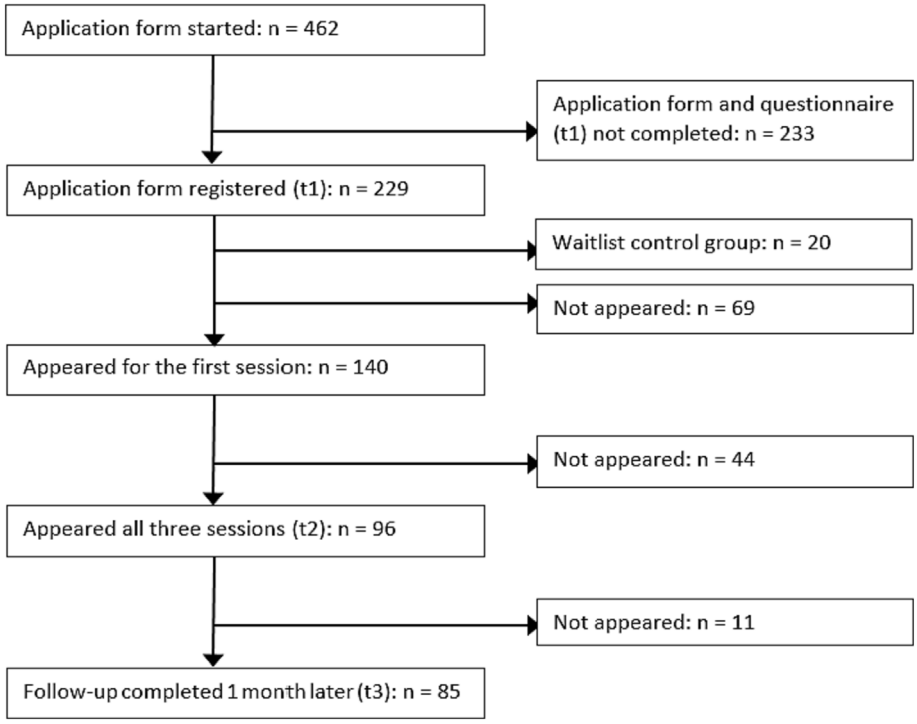

FIGURE 1 Testing points with sample group *n* and dropouts.

TABLE 1 Attrition analysis.

		Completed all training ($N = 85$)	Did not complete ($N = 124$)	Control group ($N = 20$)
	Resilience scale (mean)	56.4	53.6	56
	Female (%)	82.4	82.3	75
	Age (mean)	26.6	30.7	29.9
Education level (%)	High school or equivalent	63.5	61.2	60
	Bachelor degree	18.8	21.7	20
	Higher degree	17.6	16.9	20
Economic activity (%)	Student	75.3	62.9	65
	Employee or self-employed	23.5	29.0	35
	Unemployed, inactive or retired	1.2	8.0	—

Note: Percentages may not add to 100 due to rounding. Significance levels pertain to results of ANOVA tests for comparison of means and Chi-square tests for comparison of distribution between groups. ANOVA confirms the differences observed in age between groups as statistically significant ($n = 229$, $F = 3.398$, $p = .035$). Differences between all other observed values are statistically insignificant ($p > .05$).

up to the study were first allocated to the intervention group until a sufficient number of 40–50 were recruited and thereafter randomly allocated by list where every second sign up was assigned to the control group until a number of around 30 was obtained in the control as this was deemed sufficient for parametric statistics (after dropouts, this left the control $n = 20$). The practice of unequal randomised allocation has been commonly used where there are cost limitations in gaining a large sample (such as the present unpaid training intervention) (Torgerson & Torgerson, 2008), and other resilience interventions also use this approach, for example, Gardner et al. (2005), Sood et al. (2011), and Pidgeon et al. (2014). As Torgerson and Torgerson (2008) point out, having a larger intervention group increases statistical power when the total sample is not fixed but limited by resources only, and this can also correct for potential statistical issues such as unequal variances. Each of the training sessions comprised a 3.5 h online workshop with time divided between activities outlined in Table 2, including exercises to strengthen self-efficacy, emotion regulation skills, optimism, stress reduction, social communication, and self-acceptance. In addition, studies and scientific models and definitions of neuroplasticity, resilience, mindfulness, coping strategies, and growth mindsets were shown and

TABLE 2 Overview of training session contents.

Session	Contents	Methods
1	- Loosen-up exercise - Get-to-know-you game - Resilience definition - Factors influencing resilience - Self-efficacy expectation - Optimism - Neuroplasticity - Positive emotions - Setting goals	- Getting to know each other - PowerPoint presentation - Loosen-up exercise - Case studies in storytelling format - Individual reflection work - Voting in plenum on feedback - Learning progress via feedback journal - Exchange of experiences in pairs - Short video clip - Guided discussion in plenary
2	- Review session 1 - Discussion exercises to do at home - Coping and emotion regulation - Rumination - Social relationships - Self-worth - Setting goals	- PowerPoint presentation - Query previous content for repetition - Loosen-up exercise - Case studies in storytelling format - Individual reflection work - Voting in plenum on feedback - Learning progress via feedback journal - Exchange of experiences in groups - Short video clip - Guided discussion in plenary
3	- Review session 2 - Discussion exercises for home - Emotion regulation and mindfulness - Cognitive flexibility - Growth mindset - Mindset change and meditation - Goal setting	- PowerPoint presentation - Query previous content for repetition - Loosen-up exercise - Case studies in storytelling format - Individual reflection work - Learning progress via feedback journal - Exchange of experiences in groups - Guided discussion in plenary - Meditation

explained as a psychoeducation method. Robust treatment methods from the resilience literature were included as well as newly developed exercises.

The questionnaires were sent by email. Each of the questionnaires at the three measurement time points was completed using an individual code. The questionnaires were submitted via the Lamapoll platform, which explicitly complies with European and German data protection rules. The "Consent and Privacy Policy for Participation in the Study" was clickable with the registration form as a PDF. At the beginning (session 1) of the virtual training sessions, reference was made to the data protection provisions and how they can also be found subsequently on the registration form, as well as to the exclusive purpose of the use of data for this study, the voluntary nature of participation, and the course of the resilience training, and it was pointed out that this is a resilience training programme and not therapy (exclusion criterion). Furthermore, the netiquette in the virtual training room was outlined.

Measures

Resilience

Two scales were used to measure resilience. The Resilience Scale-11 (RS) is a short scale with 11 items measuring mental robustness and resistance. The long version was created by Wagnild and Young (1993). The shorter version is a translated and reduced variant by Schumacher et al. (2005), and the validity and reliability has been found to be very good. Our reliability analysis yielded $\alpha = .85$. Second, as a control parameter, we also used the Brief Resilience Scale. The Brief Resilience Scale indicates resilience as the ability to recover from stressors or get back on one's feet quickly. It consists of six items that are either positively or negatively worded to reduce response bias due to social desirability. Initially created by Smith et al. (2008), the German version was translated and tested by Chmitorz et al. (2018) and shown to have very good reliability and validity. Our reliability analysis yielded $\alpha = .86$.

Positive and negative mental health indicators

Coping

The German version of the Brief COPE scale was used to determine coping styles (Knoll et al., 2005). The English language version has 28 items measuring 14 different coping strategies which means that each coping style is represented by two items. In the original work by Carver (1997), the reliability was good to very good for the 14 subscales. Knoll et al. report four higher order factors (active coping, support coping, evasive coping, and positive coping) with more reliable α states compared with Carver for the German version. Our reliability analysis yielded α-values from .67 to .78 for the subscales.

Self-efficacy

The self-efficacy level was measured with the General Self-Efficacy Short Scale. The General Self-Efficacy Short Scale measures the personal conviction and self-perception of being able to successfully master problems and challenges on one's own. It is a shortened version of the scale General Self-Efficacy Expectancy developed by Schwarzer and Jerusalem (1999). This abbreviated version includes only three items and was tested using three samples of respondents from

Germany and has been shown to have high reliability and validity (Beierlein et al., 2014). Our reliability analysis yielded $\alpha = .83$.

Control beliefs

Internal and external locus of control beliefs were assessed by the Internal–External Locus of Control-4 scale (Levenson, 1972; Rotter, 1966). The Internal–External Locus of Control-4 scale is concerned with internal control beliefs, which describe whether someone believes that he or she can control events, and with external control beliefs, that is, whether an individual is convinced that his or her life is dependent on fate or chance circumstances. Testing scale homogeneity with McDonald's Omega on two samples yielded ω-values ranging from .53 to .71, thus ensuring sufficient reliability (Kovaleva et al., 2014). Confirmatory factor analyses on a German quota sample of 539 individuals confirmed factorial validity (Kovaleva et al., 2014). Our reliability analysis yielded $\alpha = .58$.

Optimism

The Revision of the Life Orientation Test was used to measure optimism (Scheier & Carver, 1985). Optimism can be described as positive outcome expectations and shows positive correlations with psychological and physical well-being. Reliability of the Revision of the Life Orientation Test has been found to be adequate (Glaesmer et al., 2008; Herzberg et al., 2006). Our reliability analysis yielded $\alpha = .82$.

Positive and negative affects

Lucas et al. (1996) and Arthaud-day et al. (2005) were able to show by means of factor analyses that Subjective Well-Being has a three-dimensional structure with cognitive satisfaction as well as positive and negative affects. Affects can be measured in a time-saving way with the Affective Well-Being SOEP Scale, which comprises four items. Test–retest correlations after several weeks have been found to yield a just adequate measure of .54 in a sample of 164 individuals, and the Cronbach's alpha values in the representative SOEP measures were .65 or higher, depending on year of measurement (Richter et al., 2017; Weinhardt & Richter, 2014). Our reliability analysis yielded $\alpha = .73$.

Exercise

Exercise was measured using a single question. As Cooney et al. (2013) state in their Cochrane review, symptoms of depression are reduced on a moderate effect level by exercise. So, one question about physical activity was added, "Approximately how many minutes of physical activity (including variations such as digging the garden, yoga, cycling, etc.) have you done in the last 7 days?"

Hardiness

A version of the Hardiness scale DRS-15 (v 3.2) was assessed for reliability and validity by Bartone (2013). We used four items from the control over one's own life subscale as the other subscales overlapped with our sense of coherence and perceived stress scale measures. Our reliability analysis yielded $\alpha = .70$.

Meaningfulness

Items from the Flourishing Scale and the Sense of Coherence Scale-L9 were included as important indicators of the sense of coherence. The Sense of Coherence Scale by Antonovsky has

been available since 1987, the short version with only nine items (Sense of Coherence Scale-L9) since 2000, and found to have good reliability and validity (Schumacher et al., 2000). The Flourishing Scale consists of eight items in the original form. The Flourishing theory is based on research conducted by Keyes (2002) on eudaimonic happiness. The German translation also yielded good reliability and validity (Diener et al., 2010; Esch et al., 2013). One item from each scale was used to measure the meaningfulness of one's life (as an important aspect of the sense of coherence). These two items were then put together to form a single scale, and our reliability analysis yielded $\alpha = .73$.

Self-esteem

Two items as excerpts from the Assessment of Quality of Life (version AQoL-8D) were used to determine self-esteem and self-confidence. Reliability tests are also available for the subscale, as are norm values for the Australian population (see Hawthorne et al., 2013; Maxwell et al., 2016). Validity has been assessed as good using multiple samples (Richardson et al., 2011). Our reliability analysis yielded $\alpha = .73$.

Social support

We measured social support with the Oslo Social Support Scale-3 (Dalgard, 1995). In the GEDA 2014/2015-EHIS study of over 24,000 people in Germany, around 18% of respondents reported that they receive little social support. As a psychosocial resource, this may have an influence on individual resilience. The Oslo Social Support Scale-3 consists of only three items and has acceptable reliability (Kocalevent et al., 2018). Our reliability analysis yielded $\alpha = .47$ at time point 1, $\alpha = .62$ at t2, and $\alpha = .70$ at t3. Therefore, we calculated scores without item 3, which resulted in Cronbach's alphas: .57 at t1, .73 at t2, and .78 at t3.

Social trust

The Breyer (2015) Social Trust Scale measures to what extent respondents trust and expect fairness from other people. This scale consists of three items with good reliability and validity (Breyer, 2015). Our reliability analysis yielded $\alpha = .84$.

Well-being outcomes and symptoms

Life satisfaction

The Satisfaction with Life Scale-1 was originally developed by Diener et al. (1985) to help individuals assess the quality of their lives on the basis of their own unique criteria. This scale has been used in numerous studies and its internal consistency shown to be very good. We used the one-item global rating of life satisfaction on the 11-point scale. This item is used almost exclusively as a measure of well-being, using the question, "How satisfied, all things considered, are you with your life at present?"

Somatisation, anxiety, and depressiveness

We used an abridged version of the Brief Symptom Inventory-18 in German (Franke et al., 2011) originally developed by Derogatis (1977). This instrument assesses the syndromes of somatisation or physical symptoms such as muscle pain and gastrointestinal problems that are often linked to stress (six items), depression (six items), and anxiety (six items). The scale has been shown to have higher reliability and convergent validity (Franke et al., 2011). Our reliability analysis yielded α-values from .76 to .83.

Stress perception

Perceived Stress Questionnaire short form is based on the developments of Cohen et al. (1983) to measure the degree to which individuals perceive "situations in their lives as uncontrollable, unpredictable and overloaded relative to their subjective coping abilities." The 20-item instrument consists of two subscales: perceived helplessness with negative items and, on the other hand, the perceived self-efficacy with positive items. The internal consistency reported in the study of Schneider et al. (2020) was high for both subscales. Our reliability analysis yielded $\alpha = .91$.

Sleep

Sleep problems can be a trigger as well as a symptom of mental illnesses and have been measured as an action outcome in resilience intervention literature (Liu et al., 2020). The Symptom Checklist-90 is an established measure for this purpose, where the area of sleep can be measured by two items as a subscale. The German version has been shown to have good reliability and validity (Franke, 2002). Our reliability analysis yielded $\alpha = .70$.

Statistical procedures

Due to forced response format in the questionnaire, no data are missing, and all included participants filled out all three measurements. We used mixed measures multivariate analysis of variance (MANOVA) to analyse differences over time in variables after the intervention and 1 month later. The data were cleaned and prepared including screening response processing time (excessively short/long response), one-sided response behaviour across scales, and a screening question, "Did you go through the questions conscientiously enough for us to use your anonymous answers for our scientific analyses?" Mean or total subscale index scores were calculated for analysis of dependent variable (DVs). All significance levels were set at $p < .05$, and alphas reported are two-tailed. Analyses were conducted using SPSS version 27.

RESULTS

Correlations of resilience

Descriptive statistics and Pearson correlations for the well-being and quality of life measures are summarised in Table 3. The correlation between the RS scale and Brief Resilience scale is $r = .61$, and the intercorrelations with other positive well-being measures are higher for the RS scale; so, for the sake of parsimony, the main analyses are conducted with the RS scale as the dependent measure of resilience.

The effects on resilience in the training group

One of our aims is to examine the efficacy of the training intervention itself over time (t1 pre-training, t2 at the end of training, and t3 in a 1 month follow-up) and in comparison with a control group. A 2×2 mixed factor analysis of variance on resilience scores with time (t1 and t2) as within-subjects factor and training group (control vs. intervention) as the between-subjects

TABLE 3 Descriptive statistics and Pearson correlations for well-being and quality of life measures at t1/baseline for the whole sample ($N = 229$).

	M	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Resilience scale	54.87	9.89													
2. Brief resilience scale	3.00	0.86	.61**												
3. Locus of control	3.69	0.57	.57**	.50**											
4. Self-efficacy	3.51	0.69	.68**	.61**	.53**										
5. Perceived stress	2.68	0.55	−.48**	−.53**	−.50**	−.51**									
6. Optimism	20.38	4.50	.59**	.55**	.59**	.58**	−.54**								
7. Sense of coherence	4.87	1.29	.63**	.48**	.52**	.43**	−.43**	.52**							
8. Self-esteem	3.29	0.82	.58**	.60**	.54**	.61**	−.62**	.61**	.53**						
9. Psychosomatics: somatisation	12.48	4.73	−.24**	−.34**	−.36**	−.33**	.56**	−.33**	−.27**	−.40**					
10. Psychosomatics: depression	14.13	4.81	−.53**	−.53**	−.44**	−.53**	.58**	−.55**	−.56**	−.71**	.51**				
11. Psychosomatics: anxiety	15.46	5.46	−.29**	−.38	−.38**	−.41**	.66**	−.43**	−.28**	−.50**	.70**	.60**			
12. Active functional coping	2.76	0.53	.30**	.04	.13*	−.11	−.08	.19**	.30**	.17**	−.04	−.14*	−.04		
13. Hardiness	16.19	2.31	.38**	.32**	.54**	.32**	−.22**	.32**	.40**	20**	−.22**	−.20**	−.22**	.19**	—

Note: Two-tailed.
*$p < .05$.**$p < .001$.

factor revealed a significant main effect of time, $F(1, 114) = 9.12$, $p = .003$, eta squared = .074, and a significant interaction between time and group, $F(1, 114) = 21.62$, $p < .001$, eta squared = .159. Post hoc *t*-tests on the interaction means show that the resilience scores of the control group did not differ between t1 (M = 56.05, $SD = 9.40$, $N = 20$) and t2 (M = 54.85, $SD = 8.79$, $N = 20$), $t(19) = 1.80$, $p = .088$. The means between t1 (M = 55.79, $SD = 9.66$, $N = 96$) and t2 (M = 61.44, $SD = 8.22$, $N = 96$) did differ significantly in the training group, $t(95) = 8.61$, $p < .001$, Cohen's $d = 0.879$ (see Figure 2).

The analysis shows a selective increase in the resilience scores between t1 (pre-training) and t2 (post-training) in the training group only and supports the conclusion that resilience can be increased by training in answer to our second aim. We can also conclude that resilience was relatively stable over the study in the control group. Unsurprisingly, there was no significant main effect of group overall, $F(1, 114) = 2.31$, $p = .132$, which was confirmed by independent *t*-tests showing that resilience scores between the control and training groups did not differ at t1 (baseline), $t(227) = .56$, $p = .579$, but did differ significantly at t2, $t(114) = 3.22$, $p = .002$, Cohen's $d = 0.792$.

Post-training follow up in the training group

A one-way repeated measures analysis of variance examined the changes in resilience over three time periods (pre-training, post-training, and 1 month follow-up) in the training group (means and Confidence interval (CI) in Figure 3). Mauchly's test was significant; therefore, Greenhouse Geiser corrections are reported. There was a main effect of time, $F(1.66, 139.74_{\text{Greenhouse Geisser}}) = 18.65$, $p < .001$, partial eta squared = .182. Sidak post hoc

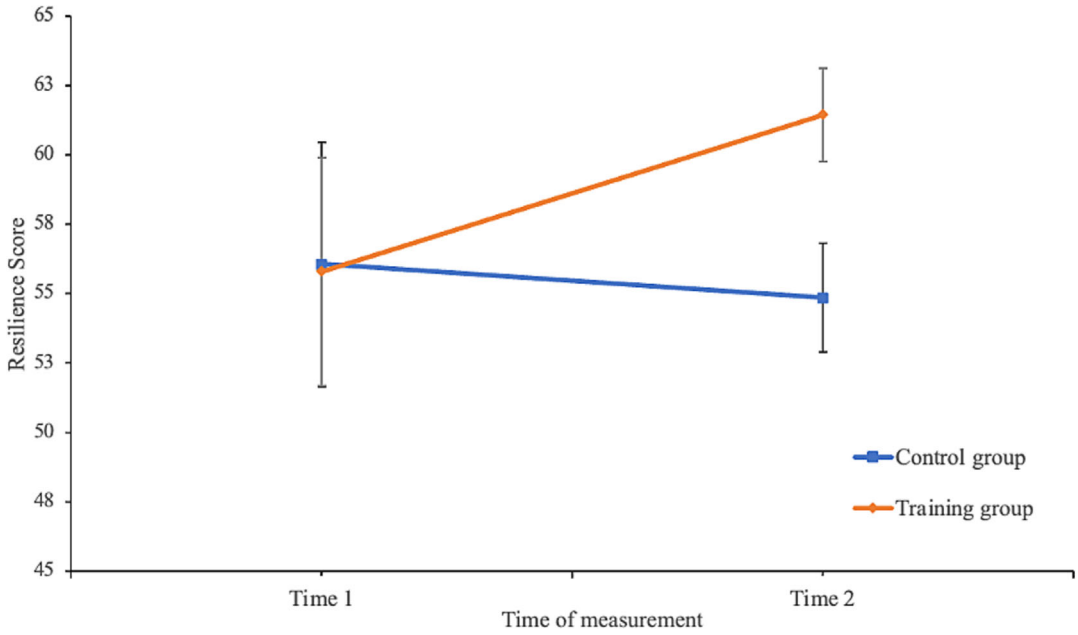

FIGURE 2 Mean resilience scores by intervention groups over time (control $N = 20$ and training $N = 96$); bars represent 95% confidence intervals.

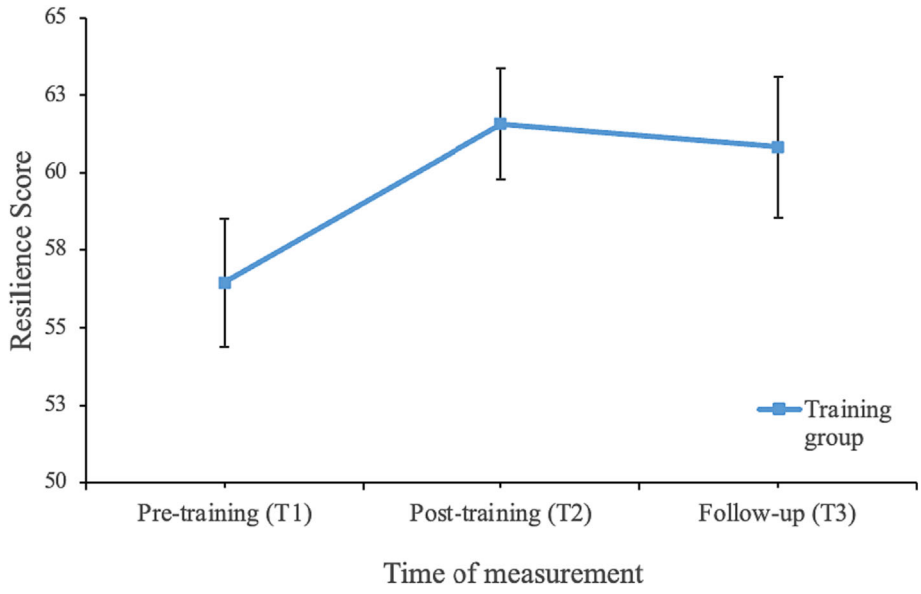

FIGURE 3 Resilience scores pre- and post-training and follow-up (1 month) in the training intervention group ($n = 85$); bars represent 95% confidence intervals.

comparisons showed that t1 (M = 56.44, $SD = 9.54$) differed from both t2 (M = 61.57, $SD = 8.33$) and t3 (M = 60.82, $SD = 10.53$), $p = <.001$, but that t2 and t3 did not differ, $p = .828$. We can therefore conclude that the effects of training on resilience were still observed during the post-study follow-up.

Omnibus effects of training on well-being and quality of life measures

The omnibus effect of training on well-being and quality of life scales was examined using a mixed model multivariate analysis of variance with time as the within-subjects factor and training group as the between-subjects factor, conducted on the dependent variables of scores on the well-being and quality of life measures: locus of control, self-efficacy, resilience (RS), brief resilience scale, self-esteem, perceived stress, optimism, sense of coherence, self-esteem, psychosomatic somatisation, psychosomatic depression, psychosomatic anxiety, active functional coping, and hardiness (see Table 4). The inclusion of all variables in the analysis provides a comprehensive examination of the intervention's impact, beyond the specific resilience model. This approach allows for a broader exploration of potential relationships and a more nuanced perspective on well-being and quality of life outcomes. By considering a wider range of variables, a more comprehensive understanding of the intervention's effects can be obtained.

There was a multivariate main effect of intervention group on a linear combination of the DVs, Pillai's Trace $F(13, 102) = 1.95$, $p = .033$, partial eta squared = .199, and also a significant multivariate main effect of time, Pillai's Trace, $F(13, 102) = 3.36$, $p < .001$, partial eta squared = .300. The interaction is of importance here and the multivariate interaction between group and time was significant, Pillai's Trace, $F(13, 102) = 2.53$, p .005, partial eta squared = .244, on the DVs. Examining the univariate interaction effects indicated that DVs

TABLE 4 Comparison between training and control groups on the measures of well-being and quality of life.

Measures	Control group		Training group		*F*	Signification	Partial eta squared
	Time 1	Time 2	Time 1	Time 2			
Locus of control	3.66	3.58	3.70	4.05	12.17	.001	.096
Self-efficacy	3.45 (0.72)	3.53 (0.64)	3.52 (0.67)	4.05	10.85	.001	.087
Resilience scale	56.05 (9.39)	54.85 (8.78)	55.79 (9.65)	61.43 (8.22)	21.61	.001	.159
Brief resilience	2.95 (1.01)	2.82 (0.086)	3.04 (0.76)	3.40 (0.73)	10.12	.002	.085
Self-esteem	3.40 (0.86)	3.52 (0.92)	3.31 (0.79)	3.70 (0.75)	3.38		.029
Perceived stress	2.81 (0.55)	2.71 (0.60)	2.63 (0.50)	2.24 (0.53)	6.75	.011	.056
Optimism	20 (4.37)	19.85 (4.14)	21.25 (4.49)	23.08 (3.97)	6.89	.010	.057
Sense of coherence	5.17 (1.18)	5.20 (1.01)	4.92 (1.37)	5.61 (1.24)	5.43	.021	.046
Psychosomatic somatisation	14.10 (5.76)	12.70 (5.46)	12.36 (4.60)	10.22 (3.84)	0.72	.396	.006
Psychosomatic depression	13.35 (4.68)	13.25 (4.30)	13.62 (4.57)	11.19 (4.24)	6.39	.013	.053
Psychosomatic anxiety	17.80 (6.45)	16.50 (5.81)	15.18 (5.45)	12.57 (4.50)	1.71	.193	.015
Active functional coping	2.97 (0.53)	2.80 (0.52)	2.74 (0.54)	2.90 (0.54)	7.50	.007	.062
Hardiness	16 (2.44)	15.65 (2.41)	16.35 (2.16)	17.46 (2.00)	8.18	.005	.067

Note: Standard deviations in parentheses.

generally differentially increased at t2 for the training group in comparison with the control group which remained stable, the only exceptions being self-esteem ($p = .068$), psychosomatic somatisation ($p = .396$), and psychosomatic anxiety ($p = .193$) which did not differentially change over time as a function of group (means and *SD*s in Table S1). Post hoc *t*-tests confirmed that training had a significantly beneficial effect on all outcome measures, while the control group showed no significant changes over time in the same measures. The results show that several other well-being measures in addition to resilience were stable over time in the control group while increasing in the training group.

Comparison of effect sizes to those of previous research

Table 5 provides a comparison of effect sizes from our results compared with previous literature. We have chosen recent studies for comparison that have interventions in an RCT or CT design, a similar duration to our study of 10 h in total, and an adequate sample size for statistical comparisons. Our values are at least equal to those of other studies and, in most cases, exceed them by showing high effect sizes. However, effect size estimates can be less accurate and overly large with small samples, and caution must be taken in interpreting these effects.

Trajectories of resilience and recent life events in the training group

In the whole sample (including control group), baseline resilience at t1 was higher in those who reported a recent strong positive event (M = 57.29, $SD = 9.51$, $N = 34$) than those who reported a strong recent negative event (M = 52.98, $SD = 9.38$, $N = 61$), $t\ (93) = 2.14$, $p = .03$, 95% CI [0.31, 8.32], Cohen's $d = 0.457$). However, by t2, the difference in resilience was not significant between those reporting a positive event (M = 57.08, $SD = 7.77$, $N = 13$) or negative event (M = 60.78, $SD = 10.23$, $N = 23$), $t\ (34) = 1.13$, $p = .265$, Cohen's $d = 0.393$, 95% CI [−10.36, 2.95]). This shows a bounce back effect in the subgroup experiencing a recent negative event. As we were interested in examining potential differential effects of training on those experiencing recent significant life events, we plotted the resilience scores for the training group over time. In the training group alone, the trajectory of resilience scores was examined as a function of reporting a recent strong life event (positive, negative, or none) (see Figure 4). We examined the question of whether training may have a differential effect on resilience depending upon experience of a recent strongly emotional life event prior to starting the study. There was no evidence of differential effects in the training group as the interaction was not significant, $F(3.33, 136.43_{\text{Greenhouse Geisser}}) = 1.76$, $p = .15$, eta square .041, and there are wide confidence intervals and small *N* in positive and negative event groups.

As these group results could be unduly affected by dropouts, we calculated gain or change scores in resilience in the training group as a further way to analyse resilience over time for those experiencing recent significant life events. Resilience changes at t2 did not differ between participants reporting a strong recent positive or negative life event at the outset of the study. This suggests that the effects of training were not differentially affected dependent on recent significant life events reported at the start of the study. However, with very small *N*, it is hard to make firm conclusions about the interaction of significant life events and training.

TABLE 5 Comparison of the effect sizes found in previous studies and the present study.

	Vanhove et al. (2015) (meta-analytic review of four studies)	Abbott et al. (2009)	Akeman et al. (2020)	Hechanova et al. (2023)	Zhang et al. (2022)	Our study
Setting and number of participants in the intervention group	Computer-based resilience setting (RCT design) ($n = 465$)	Online resilience training setting (RCT design) ($n = 26$)	Group-based resilience training (CT design) ($n = 126$)	Online resilience training setting (RCT design) ($n = 135$)	Online resilience training setting (RCT design) ($n = 34$)	Online group resilience training setting (RCT design) ($n = 97$)
Sample characteristics		Sales managers based in home offices in rural and urban Australia	First year students over 18 years old and not reporting mental or physical health problems	Filipino students currently enrolled in any college or university, aged 18 to 25 years old with no mental health problem	Nursing home residents with suicidal ideation in a Chinese province	German university students and working participants, with no mental or physical health problems
Duration and number of training sessions	Different	10 weeks (no exact time provided)	Four weekly sessions of 50 min = 3.3 h	6 weeks with each 1.5 to 2 h = 9–12 h	8 weeks with 60–90 min = 8–12 h	3 weeks with each 3 to 3.5 h = 10 h
Resilience	0.16 (no effect)	—	0.09 (no effect)	—	0.79 (medium effect)	1.73 (high effect)
Stress (reduction)	—	0.2 (small effect)	0.24 (small effect)	0.30 (small effect)	—	1.63 (high effect)
Depressiveness (reduction)	—	0.2 (small effect)	0.25 (small effect)	0.28 (small effect)	0.71 (medium effect)	1.24 (high effect)
Anxiety (reduction)	—	0.2 (small effect)	0.15 (no effect)	0.16 (no effect)	0.37 (small effect)	1.23 (high effect)
Somatisation (reduction)	—	—	—	—	—	1.23 (high effect)

TABLE 5 (Continued)

	Vanhove et al. (2015) (meta-analytic review of four studies)	Abbott et al. (2009)	Akeman et al. (2020)	Hechanova et al. (2023)	Zhang et al. (2022)	Our study
Quality of life	—	0.2 (small effect)	—	—	—	—
Life satisfaction	—	—	—	—	—	0.93 (high effect)
Optimism	—	—	—	—	—	1.21 (high effect)
Sleep problems (reduction)	—	—	—	—	—	0.81 (high effect)
Negative affect (reduction)	—	—	—	—	—	1.44 (high effect)
Positive affect	—	—	—	—	—	1.50 (high effect)
Social confidence and trust	—	—	—	—	—	1.37 (high effect)
Social support	—	—	—	—	—	0.78 (medium effect)
Sportive activities	—	—	—	—	—	0.08 (no effect)
Active functional coping	—	—	—	−0.08 (no effect)	—	0.61 (medium effect)
Cognitive functional coping	—	—	—	0.30 (small effect)	—	1.17 (high effect)
Dysfunctional coping (reduction)	—	—	—	—	—	0.81 (high effect)
Resilience as ability to recover from stressors	—	—	—	—	—	1.13 (high effect)

(Continues)

TABLE 5 (Continued)

	Vanhove et al. (2015) (meta-analytic review of four studies)	Abbott et al. (2009)	Akeman et al. (2020)	Hechanova et al. (2023)	Zhang et al. (2022)	Our study
Hardiness	—	—	—	—	—	1.02 (high effect)
Self-efficacy	—	—	—	—	—	1.83 (high effect)
Self-esteem	—	—	—	—	—	1.31 (high effect)
Locus of control	—	—	—	—	—	1.34 (high effect)
Purpose in life/ sense of coherence/ meaning	—	—	—	—	—	1.19 (high effect)

Note: Intervention effect size calculated and reported here as Cohen's *d*.
Abbreviation: RCT, randomised controlled trial.

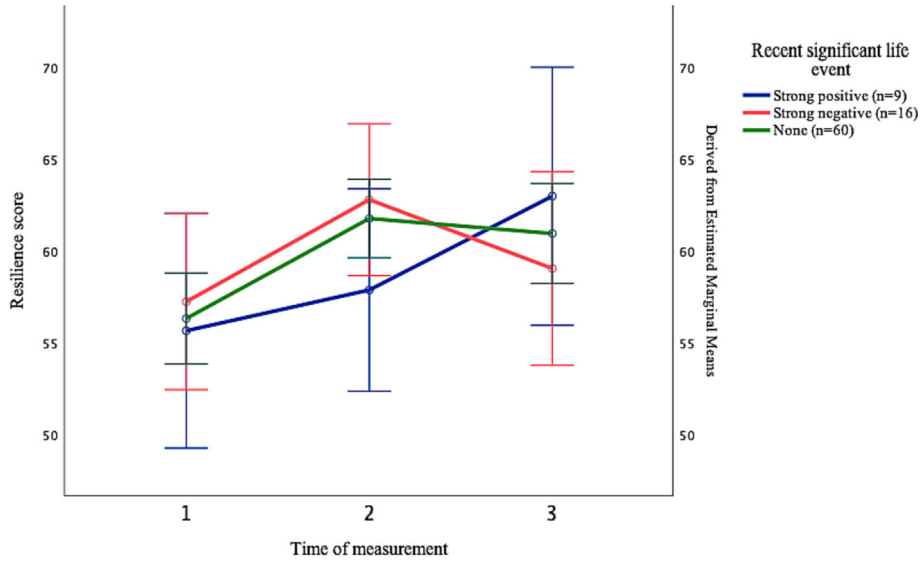

FIGURE 4 Resilience scores over time in the training group as a function of reporting a recent strong life event (bars represent 95% confidence intervals).

DISCUSSION AND CONCLUSION

Our study had two main aims, to test the efficacy of a novel training intervention in improving resilience and other indicators of well-being (life satisfaction, anxiety, stress, and meaningfulness) and to measure the trajectory of resilience over the training period dependent on reported significant life events. We believe that, although resilience may be a relatively stable construct, it is made up of factors that are malleable to targeted training interventions. To achieve these aims, we conducted an RCT with a German general population sample predominantly of students though also working people. Results showed that a novel training intervention of around 10 h duration does boost resilience and other related well-being measures in comparison with a control group that did not receive training. We found that it is possible to significantly improve various resilience factors with high effect sizes even in a short timeframe, though we must exercise caution over effect sizes from small samples. In addition to resilience, the training intervention had a positive effect on other measured quality of life and well-being indicators overall, and we observed increases in factors such as locus of control, self-efficacy, optimism, sense of coherence, self-esteem, active functional coping, and hardiness and decreases in negative outcomes such as psychosomatic symptoms and perceived stress. Furthermore, this stable boost in several traits was measurable in a 1 month follow-up, which shows that trait changes do not rely on expectations. Aspects such as self-efficacy and positive affect can be increased and boost resilience. The comparison between groups supports the idea that well-being and quality of life can be improved with a brief training intervention. This suggests that it can be possible to shift relatively stable traits even in short durations without using psychotherapy or highly impactful life events. We would argue that this is impetus for development of resilience broad-based training programmes which could be utilised in organisational and educational settings to deal with work or study stress or for general therapeutic means and self-help. We cannot say if the effects of a one-off training would be sustained over a longer period of time, and the techniques would

need to be regularly practised for gains to be sustained. Researchers should focus on developing training interventions that are self-sustaining over time and equip individuals with a toolbox of techniques with which to augment and sustain well-being in response to life stressors, and that these should take into account that multiple factors influence resilience. Existing literature shows a minimum of 10 factors contributing to resilience and even up to around 20 described in the Cochrane review of meta-analyses by Kunzler et al. (2020).

Resilience scores for the whole sample (including the control group) at t1 showed that those who reported experiencing a recent significant negative life event had lower resilience scores compared with those reporting a recent positive life event; however, by t2, the difference had disappeared. Though this could be affected by dropouts, this does indicate a bounce back effect and suggests that resilience scores might be relatively stable, with a baseline level that an individual returns to after a period of adjustment, consistent with theoretical explanations of resilience (Noble & McGrath, 2012). This finding needs replication with a larger sample. We had expected that the effects of training might be larger for those experiencing recent negative life events, as there is more scope for improvement, but neither the trajectories of resilience in the training group nor change/gain scores were affected by reports of recent significant life events before the training started (at t1), but there was very small N in the life event groups which mean generalisations cannot be made from this finding. The effects of resilience training therefore did not appear to be influenced by experiencing a recent significant emotional life event in the weeks before the study and was equally effective for all. That is notwithstanding that this could have been affected by significant events happening to the participants during the course of the training which was not measured in the present study.

The effect sizes for training found in our study were large with a partial eta squared of .16 for the interaction effect of intervention group $\times$ time on changes in resilience, and the change between resilience scores for the training group between t1 and t2 was $d = 0.88$, which represents one of the higher effect sizes reported in the literature with previous studies reporting small to moderate effects (Abbott et al., 2009; Liossis et al., 2009; Millear et al., 2008; Vanhove et al., 2015). Temporal precedence can be a threat to validity (Nezu & Nezu, 2008). Therefore, we asked the participants at t1 before the intervention if they already gained knowledge about resilience and, if so, how informed they are about the topic. Another critical aspect regarding internal validity can be historical circumstances. To control these issues, we started the intervention training groups in mid-May and beginning of June 2021. The pandemic during that time in Germany was at a quite stable level (below 100 cases per 100,000 habitants).

Limitations

We acknowledge several limitations of this study that need to be addressed in future, particularly in order to increase confidence in the generalisability of our findings. First, the findings must be replicated in future work with wider and more diverse samples. The same issue applies to the positive effects of our resilience training which would benefit from replication. A second limitation which is a factor in pre-post-test designs relates to dropouts. Nezu and Nezu (2008) have warned of the dangerous effects of attrition on the internal validity of results and generalisability. Although dropouts in our study are comparable with those in similar studies and the attrition analysis did not identify any specific concerns, strategies are needed to recruit and retain a larger number of participants. A third limitation is the duration of the study; longer term follow-ups on the sustained effects of training are needed. The short period of the study

and follow-up 1 month later also raises questions as to whether the necessary effects of trained resilience skills had taken place. We cannot rule out expectation or Hawthorn effects, demand characteristics, or regression to the mean influencing results. This limitation is shared by other resilience interventions, and future studies would benefit from different control groups where participants engage in placebo training tasks. Longer term follow-ups are required to ensure the benefits of resilience training remain stable over time.

Conclusions

This study has contributed to understanding of the impacts of resilience training for individual well-being. We have presented findings from a novel comprehensive resilience training intervention founded on our understanding that building resilience as a multifaceted set of processes and traits offers a mechanism for enhancing well-being through increasing the ability to cope with well-being challenges. Using an RCT approach with a diverse German sample with the majority drawn from a student population, we have measured the effectiveness of the intervention to provide insight into its impacts and act as a proof of concept for the resilience training intervention. We find the training intervention does boost resilience and other related well-being measures in comparison with a control group that did not receive training. With effect sizes measured in Cohens *d*, the novel training seems far more effective than existing ones, which claim mostly small effects. We believe that modelling resilience factors in future studies to provide insight into the factors that have most influence would provide a useful contribution to understanding of resilience as a concept and its determining factors, and development of models derived from larger data sets is an important direction for future research as a goal in itself.

CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to declare.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ETHICS STATEMENT

Ethical clearance was received from the HMKW Hochschule für Medien, Kommunikation und Wirtschaft.

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SUPPORTING INFORMATION

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

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