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Exploring meaning in life through a brief photo-ethnographic intervention using Instagram: a Bayesian growth modelling approach

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ABSTRACT

The 4th Industrial Revolution has provided several digital platforms through which to disseminate scalable and cost-effective interventions (e.g. Apps and Social media). Instagram, a popular visual-ethnographic social media platform, could be employed to implement and scale interventions aimed at aiding individuals in discovering meaning in life and gratitude through capturing and reflecting upon photographs of meaningful moments. The purpose of this study was to evaluate the long-term effectiveness of a brief photo-ethnographic meaningful-moments intervention aimed at enhancing wellbeing (life satisfaction) and managing common mental health problems (stress/depression/anxiety) through Instagram. A 4×1 treatment-only intervention design was used to assess the immediate and long-term changes in meaning, gratitude, life satisfaction, and depression/stress/anxiety. Within-person development on the subscales was evaluated with Bayesian level and shape models. The results showed significant improvements in all factors directly after the intervention. Over the long term, significant changes with baseline measures for the presence of meaning, appreciation for others, and life satisfaction was found. Participants also reported a significant but small change in depression over the long term. Instagram could therefore be an interesting tool to consider when the aim is to enhance well-being and manage common mental health problems in the short-, medium- and long-term.

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Introduction

The World Health Organisation (2020) reported that more than one billion people are suffering from some form of severe mental illness which ranges from mood disorders (e.g. chronic depression, bipolar) to psychosis (e.g. dementia or schizophrenia). Eylem et al. (2020) adds that 20% of the global population presents with common mental disorders such as stress, depression and anxiety. Despite the high prevalence of severe psychopathology, recent studies have also suggested that one in four people reported an inability to cope with current life-related challenges which severely impacted their relationships, mental health and overall psychological wellbeing (Rehm & Shield, 2019). There is therefore a massive need for psychological services, yet access to treatment is hindered by the stigma attached to mental health treatment, the availability of- or access to psychological services and treatment costs (Eylem et al., 2020; Triliva et al., 2020). Recent surveys suggested that most individuals do not believe that mental health care is accessible (National Institute of Mental Health 2018), yet more than 70% of people report mental health care needs (Roy et al., 2020). Further, a commissioned report by Lancet on global mental health care showed that mental health care would cost global economies more than $16 trillion per year; however, such care is largely underfunded by governments, and the cost of care for most of the world's population is still unaffordable (Patel et al., 2018).

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Supplemental data for this article can be accessed here.

In many ways, this high demand for–and the low supply of–psychological services sparked the revolution of self-help initiatives aimed at promoting mental health (Van Zyl, Hulshof, et al., 2019). These initiatives range from self-help books and online courses to digital apps and online support groups (Van Zyl & Rothmann, 2019). These tools are framed positively (e.g., how to be happier, being more mindful and finding meaning in life), which distracts from the stigma attached to mental health care, and on the surface, seem perfect for people struggling to cope with everyday life issues. These interventions are easy to scale and are readily adopted by the market as they are not only convenient to use, but promise radical changes in health, happiness and wellbeing (Van Zyl, Hulshof, et al., 2019). However, most of these types of interventions are not scientifically valid, and studies have shown that they rarely work as intended (Roll et al., 2019; Van Zyl, Efendic, et al., 2019).

As such, applied researchers have started to develop cost-effective, scientifically valid and scalable solutions to provide psychological services to those who need it most (Steger et al., 2014; van Zyl, Hulshof, et al., 2019). Ideally, these interventions could be independently completed, from any location, on platforms that are free (or inexpensive) and do not necessarily require the input from a professional. By taking the psychologist or counsellor out of the equation, and providing a scientifically valid and scalable 'self-help' psychological intervention, one can remove the barriers to access such as the cost of service, access to care, and geographical or health insurance limitations. If researchers and practitioners can utilise and optimise the resources already available to individuals, they might be able to help participants live healthier, happier and more meaningful lives, regardless of their financial status or geographical location (Cox & Brewster, 2018).

One way through which researchers and practitioners can scale interventions is through the internet (Lal & Adair, 2014). The rise of the 4th Industrial Revolution has resulted in the rapid adoption of internet orientated services, connected devices and platforms through which to connect communities and enhance wellbeing (Mayer et al., 2020). Research shows almost 75% of the world's population has access to cell phones and relatively stable internet (Kardos et al., 2018), with the number of connected devices and people increasing daily (Mayer et al., 2020). Therefore, designing interventions to run on cell phones and using the internet seems to be a viable means to disseminate psychological interventions. e-Mental Health applications and platforms have therefore become popular during recent years (Kelders, 2019). These interventions employ sophisticated and fit-for-purpose online platforms to not only enhance wellbeing, but also to ensure that individuals adhere to intervention protocols and actively engage in treatment plans (Kelders et al., 2020). Despite these technologies showing promising effects for enhancing mental health and wellbeing, and that they are easily scalable, the design and maintenance costs are significantly higher than any other form of traditional therapeutic interventions (Köhnen et al., 2019). Therefore, for the average practitioner, designing and implementing e-Mental Health interventions may not yield any financial returns in the short- or medium-term.

The 4th Industrial Revolution gave rise to another promising means through which interventions could be scaled using cell phones and the internet: social media (Santesteban-Echarri et al., 2018). Social media refers to online network-based communication platforms where individuals can create unique profiles, connect with others, and generate or engage in user-generated or system-provided content (Kaya & Bicen, 2016). Social media sites, such as Facebook and Instagram, provide a popular platform through which to share one's personal views and provide a means through which to connect to other similarly minded individuals (Han, 2018). As of 2018, more than 3.3 billion people reported to have at least one social media account or profile, with many more having the potential to create accounts (Han, 2018; Valentine et al., 2019). Valentine et al. (2019) reported that 89% of social media users access or check their social media profiles daily, with 60% thereof checking it at least 5 times a day. Sha et al. (2019) reports that social media messaging has become the predominant way through which people communicate with others on a daily basis (surpassing telephone calls, emails and even face-to-face interaction). Further, social media sites and platforms such as Facebook, Tencent QQ, Whatsapp and YouTube are consistently on the list of Top 10 daily most accessed websites (Amazon, 2020). Social media is therefore omnipresent, and well-integrated into the daily lives of individuals. Given that most individuals are already familiar with social media, developing interventions around these platforms would ensure higher levels of adherence to treatment protocols as they are easy to use, relatable, convenient and engaging (Santesteban-Echarri et al., 2018). Developmental costs are also significantly reduced, as these platforms are usually freely

available. However, research on the use of social media to help people grow and develop is limited, although it is an area of obvious promise for applied psychological research (Van Zyl, Hulshof, et al., 2019).

The use of social media as a platform to disseminate psychological interventions is therefore a relatively new phenomenon (Valentine et al., 2019). Researchers are still debating whether social media interventions should be employed as an alternative to therapy or as a means through which to supplement traditional interventions (Santesteban-Echarri et al., 2018). Currently, only a handful of social media orientated interventions exist, all of which act as supplements to larger intervention protocols (Santesteban-Echarri et al., 2018; Valentine et al., 2019). As such, no valid and reliable self-help social media specific psychological intervention exists (Santesteban-Echarri et al., 2018). An effective starting point to test the viability of social media platforms to facilitate self-help interventions is to modify and transpose a traditional self-help intervention to be used on these platforms.

A promising traditional positive psychological intervention which could be transposed for use on social media is the photo-ethnographic meaning-making intervention of Steger et al. (2014). In Steger et al.'s (2014) study, the authors employed a photo-ethnographic approach to aid participants in exploring and reflecting upon the sources of meaning in their lives through photography. Steger et al. (2014) argued that meaning in life is an important factor that contributes to one's mental health and overall wellbeing. If individuals are engaging in meaningful activities, they are more likely to experience higher levels gratitude, life satisfaction and lower levels of stress, depression and anxiety (Steger et al., 2006). Meaning has been shown to be the most important predictor of overall life satisfaction and longevity in various long-term studies on happiness, health and physical well-being (Steger, 2019). However, many individuals are not consciously aware of the sources of their meaning and need to be assisted in discovering such sources in a structured and creative manner (Steger, 2019). Steger et al. (2014) argued that one could employ photography to aid individuals in both becoming more mindful of meaningful experiences and allowing for later reflection on why the experiences were meaningful (as they have been captured on film).

As such, Steger et al.'s (2014) positive psychological intervention study employed an offline design, where participants were required to utilise a digital camera to capture moments throughout a given day that they found to be particularly meaningful or positive. Individuals were required to take one or two photos each day for a period of seven days. At the end of the process, the authors facilitated a group reflection session, where the sources of meaning were discussed and the major themes emanating from a given participant's photos were established. The intervention aimed to help individuals to discover the sources of meaning in their lives and was developed around the theoretical modalities of Acceptance and Commitment Therapy (ACT: Hayes et al., 1999). From this perspective, the intervention aimed to aid individuals in (a) becoming more aware of the present moment (mindfulness), (b) developing a transcendent sense of the self (self-reflection/self-insight), and (c) discovering and clarifying aspects that one deeply cares about (values). The results of the intervention showed that it had immediate positive effects on experiences of meaning in life and life satisfaction; however, it did not reduce experiences of common mental health problems like depression, stress or anxiety (Steger et al., 2014).

Despite showing promise, their study had several content and methodological limitations. First, it did not attempt to understand the short-, medium- or long-term effects of the intervention, as their study specifically focussed on the immediate effects thereof. Psychological interventions rarely show significant immediate effects, and those that are shown are rarely sustained over time (Bolier et al., 2013; Donaldson et al., 2019; Roll et al., 2019) Further, the true effect of the intervention can only be seen over an extended period (Van Zyl, Efendic, et al., 2019). Second, their intervention aimed to enhance self-insight through active self-reflection on meaningful moments; however, this was done at the end of the intervention, and not a requirement for the duration. As such, no means through which to practice the skill was provided, and participants may not have had time to process the meaning of events in a short group facilitated session. Third, despite arguing that their intervention is built around the principles of ACT, Steger et al. (2014) ignored a fundamental supporting element of the theory: the importance of employing contextual resources such as social support networks. Finally, their sample mainly consisted of a heterogenous student population from the United States, and therefore their results were not generalisable.

Given the nature of Steger et al.'s (2014) intervention and its promising immediate effects, a modified version addressing the aforementioned limitations could be disseminated through a visually centred social media platform such as Instagram. Instagram is

a popular visual-ethnographic social media platform with more than a billion active users daily. It allows individuals to capture, share and engage with visual media, such as photos and short videos, and provides a means through which to connect with other like-minded individuals. Given the photographic nature of Steger et al.'s (2014) intervention, the visual-centric nature of Instagram provides an adequate platform through which to disseminate a modified version of the intervention and could therefore lead to an interesting, cost effective scalable solution to aid individuals in enhancing their experiences of meaning, mental health, and wellbeing through photography.

Literature review

In order to develop, implement and evaluate such an intervention, context needs to be provided as to the theoretical components underpinning the intervention (meaning and its outcomes), understanding the sources of meaning in life, and reflecting on the role social media could play in helping individuals discover the sources of meaning in their lives. This could provide context to why Steger et al.'s (2014) intervention was effective in enhancing meaning and life satisfaction but not for common mental health problems (depression, anxiety and stress). It could also inform how the intervention could be modified to ensure its effectiveness when using social media as a means through which it can be disseminated.

Meaning in life and its outcomes

Experiencing meaning in life is an important life goal for individuals, as it provides individuals with a reason for existence, which in turn has positive effects on various important life outcomes such as happiness, longevity, career progression and the like (Steger, 2019). Meaning is conceptualised as the experience where one feels connected to the proverbial bigger picture which is a function of (a) a comprehension of one's inner/outer world, (b) a need to find direction in actions or life, and (c) a need to find value of and in one's life. Steger et al. (2006) argued that meaning in life is fundamentally broken down into two facets: the *search* for meaning and the *presence* of meaning in life. The *search* for meaning involves an active pursuit of meaningful activities, whereas the *presence* of meaning pertains to a feeling that one is connected to something greater than the self, that life and one's contributions to the world are worthwhile (Steger, Oishi et al., 2009). While the search for meaning can be experienced either positively or negatively (depending on one's feelings of success or failure with the search), experiencing the presence of meaning in life tends to be overwhelmingly positive (Steger et al., 2014). It is important to note that meaning is not just a function of positive experiences or positive sources, but can also be derived from negative events, such as failures at work/in relationships, loss of a loved one, health challenges or severe psychological trauma (Vohs et al., 2019). Whilst these events may bring about pain and suffering in the moment, they may promote an individual's efforts to comprehend how these events 'make sense' and how such can be integrated into their current understanding of the world over time (Vohs et al., 2019).

Whilst it is unlikely that meaning is actively derived in the moment of these negative experiences, the motivation to understand how negative events serve a purpose or function in life comes with acceptance and reflection (Wong, 2019). Steger et al. (2014) explained that creating and attributing meaning to life is a core component of Acceptance and Commitment Therapy (ACT), a type of mindfulness-based therapeutic approach that encourages patients to mindfully prioritise progress towards valued goals, ultimately prioritising a meaningful life (Blackledge & Hayes, 2001; Hayes et al., 1999). Rather than try to reduce symptoms or avoid negative emotions, ACT aims to change one's reactions to thoughts and feelings by promoting active acceptance. In the pursuit of valued or meaningful goals, individuals can experience anxiety, but rather than attempt to avoid such, individuals should be encouraged to accept this as a necessary part of the goal pursuit process (Arch & Mitchell, 2016). Instead of focussing on emotion regulation (i.e. controlling emotional responses to negative experiences), individuals could learn to accept negative events, and by doing so, these experiences would often lose their power or hold over the individual's life (Blackledge & Hayes, 2001).

In essence, ACT aims to alter the way in which individuals perceive their *context*, rather than attempting to change the physical content of a psychological experience that turns into value-based actions (Hayes et al., 1999) which leads to meaningful life experiences (Steger et al., 2014). To achieve this, Hayes et al. (1999) stated that ACT draws from functional contextualism, and proposes meaningful life experiences are the outcome of six core psychological processes:

a. *Radical Acceptance*: Permitting negative or undesired psychological experiences to enter and

exit consciousness without active engagement or judgement.
b. *Cognitive diffusion*: Reducing reification of inner processes such as thoughts, feelings and desires.
c. *Being present*: Ensuring mindful attention to the ongoing ebb and flow of internal and external experiences in the moment.
d. *The Self-As-Context*: Developing a transcendent sense of the self through self-discovery and reflection.
e. *Clarifying Values*: Understanding and reflecting upon those aspects that one deeply cares about or finds particularly meaningful.
f. *Commitment to action*: Actioning behaviours necessary to align goals to personal values in service of a meaningful life.

When these six core psychological processes are aligned, individuals are able to accept negative life experiences, understand what gives their lives meaning, and be mindfully aware of the sources of meaning (Rush et al., 2019). Research suggest that this has numerous benefits for the individual. First, experiences of meaning enhance wellbeing, positive emotions, gratitude, self-esteem, optimism, and life satisfaction (e.g., Chamberlain & Zika, 1988; Compton, Smith, Cornish, & Qualls, 1996; Debats et al., 1993; Steger & Kashdan, 2007; Steger, Oishi, et al., 2009; Zika & Chamberlain, 1992). Second, benefits also extend to physical health, with meaning in life relating to self-reported general health, physical activity and longevity (Krause, 2004; Steger et al., 2009). Finally, meaning also acts as a buffer against the onset of common mental health problems and pathology, such as depression, stress, anxiety, fear and suicide ideation (Harlow et al., 1986; Steger, Mann, et al., 2009; Steger & Kashdan, 2009). Taken together, when the six psychological processes of ACT are in place, this leads to experiences of meaning in life that in turn positively affect mental health/wellbeing (gratitude and life satisfaction) and reduce experiences of common mental health complaints (stress, depression, and anxiety) (Chamberlain & Zika, 1988; Day & Rottinghaus, 2003).

Given the importance of meaning for people's mental health, it seems especially useful to design interventions targeting the development of such (Steger et al., 2014). Meaning-focussed interventions should aim to enhance individuals' capacity to search for meaning by helping them discover the sources of meaning in their lives (Van Zyl, Hulshof, et al., 2019). However, despite the functional importance in enhancing wellbeing and reducing psychological distress, there is no 'one-size-fits-all' approach or attributing factor through which to experience and discover meaning (Steger, 2019).

Ways to and sources of meaning

Various studies have shown that the sources of meaning are plentiful, and that meaningful experiences are caused by different things for different people (Steger, 2019; Van Zyl, Hulshof, et al., 2019). Meaning is a uniquely subjective, individualised experience and is the result of an interplay between the external environment and one's subjective interpretation of its purpose/function in one's life (O'Connor & Chamberlain, 1996). Given such, it is not surprising that there is no consensus in the literature as to what specifically causes meaning. For example, O'Connor and Chamberlain (1996) argued for six sources of meaning ranging from religion and spirituality, social and political factors, to the relationship with nature, personal development, creativity, and relationships with people. Others have argued that meaning stems from up to 26 different source categories ranging from self-knowledge, freedom and power to fun, comfort, and harmony (*c.f.* Table 1 in Schnell, 2009). Van Zyl et al.

Table 1. Characteristics of the participants ($n = 53$).

Item	Category	Frequency	Percentage (%)
Gender	Male	10	17.2
	Female	48	82.2
Age	19–25 years	4	6.9
	26–30 years	11	19.0
	31–40 years	24	41.4
	41 and older	19	32.8
Nationality	European	23	39.7
	South African	29	47.2
	American	3	5.2
	Other	3	5.2
Marital status	Single	15	25.9
	Living together	13	22.4
	Married	26	44.8
	Divorced	3	5.2
	Widowed	1	1.7
Native Language	English	15	25.9
	Dutch	16	27.6
	German	2	3.4
	Afrikaans	21	36.2
	Other	4	6.9
Highest level of Education	High School/GED	3	5.2
	Some College	4	6.9
	Bachelor's Degree	19	32.8
	Master's Degree	25	43.1
	Ph.D.	7	12.1
Employment Status	Full Time	40	69.0
	Part Time	12	20.7
	Full Time Student	4	6.9
	Unemployed	1	1.7
	Retired	1	1.7
Pictures Taken/Posted	1–3 Photos	6	10.3
	4–5 Photos	13	22.4
	6–7 Photos	39	67.2

(2019), on the other hand, found that amongst other relationships, savouring life's pleasures, autonomy, kindness, fulfilling work and even caring for pets were important sources of meaning for individuals. Still others have found every individual may personally report between one and five areas of meaning for themselves (Schnell, 2011). Ultimately, what constitutes and leads to meaning is a deeply subjective experience, and therefore the routes to meaning differ significantly between people (Steger, 2019). Depending on the person, this can be challenging to develop, but an essential element is paying attention to and taking the time for reflecting upon what makes life subjectively meaningful (Van Zyl, Roll, et al., 2020). However, individuals do not necessarily have the skills, abilities and/or resources needed to actively reflect upon the sources of meaning in their lives (Steger et al., 2014).

Disabato et al. (2017) argued that mindfulness and appreciation seem necessary for discovering the sources of meaning in one's life. That is, in order for people to discover the sources of meaning in their lives, they might need to practice mindful awareness and honour discovered experiences through showing appreciation or gratitude (Disabato et al., 2017; Kleiman et al., 2013). Given the pressures of modern-day life and the inability to disconnect from work, individuals rarely have the capacity or the time to reflect upon those aspects which bring about meaning; they might not take the extra moment to reflect on positive relationships they have, nor on small pleasures they are enjoying (Seligman, 2012; Van Zyl, Rothmann, et al., 2020). Upon retrospective reflection, individuals can recall positive and meaningful experiences; however, they are not able to describe why these events may have been meaningful (Van Zyl, Hulshof, et al., 2019). Individuals also find it difficult to identify meaningful experiences as they occur (Seligman, 2012). This is a function of both a low level of mindfulness, but also a lack of conscious awareness of what makes life meaningful. Cultivating a disposition of mindfulness, gratitude and guided self-reflection could aid individuals to become more consciously aware of the sources of meaning, and reinforce the importance of sources of meaning as they occur (Steger, 2009). Finding and experiencing meaning therefore takes both conscious effort, and positive reinforcement (Steger, 2009).

Meaning, social support, and social media

Social support plays a big role in not only discovering what one perceives as being meaningful, but also in reinforcing and extending the positive benefits of the experiences when they occur (Krause, 2007; Wong, 2019). For most people, relationships are a big part of what makes a meaningful life (e.g., Debats, 1999; Wong, 1998). Even despite fundamental differences in scientific opinions about the sources of meaning, all approaches agree that positive relationships and social support play a major role (O'Connor & Chamberlain, 1996; Schnell, 2011; Steger, 2019; Van Zyl, Hulshof, et al., 2019). Individuals who have strong social support networks in place, and positive relationships with family members and close friends are more likely to report having meaning in life or at work (Krause 2007; Steger, 2019). Krause (2007) found that when individuals believed that others would provide assistance in the future and that they could rely upon emotional support from friends/family members, they were more likely to experience a deeper sense of meaning over time.

Given the fact that social support adds meaning, then one way to try to boost meaning would be to use social media. Social media has systematically become the most widely used means of communication in modern times, surpassing e-Mail, text messaging and even telephone calls (Kaya & Bicen, 2016). Social media not only provides a platform through which to both establish, and maintain relationships with new contacts or within existing social networks (Muscanell & Guadagno, 2012; Steinfield et al., 2008), but it also acts as a means to facilitate social learning (Kaya & Bicen, 2016) and build self-esteem (Iranmanesh et al., 2019). Blight et al. (2015) found that active social media engagement enhances social capital, facilitates systematic self-disclosure (necessary for building relationships) and increases life satisfaction over time. Houghton et al. (2020) further found that social media sites not only contribute positively to wellbeing, but also address individuals' fundamental needs for safety, belongingness, and social self-actualisation. The fundamental reason for these positive effects is that social media capitalises on our social needs and creates a virtual environment for individuals to find communities that accept them for who they are (Houghton et al., 2020). Social media helps individuals feel that they belong, and to belong makes individuals feel like their lives matter (Lambert et al., 2013).

As such, social media could act as a powerful tool to actively infuse social elements into traditional psychological interventions that aim to enhance wellbeing (Van Zyl, Hulshof, et al., 2019). Interventions which employ social media could provide a sense of

community (i.e. a sense of belonging) and increase feelings of similarity and shared identity. Interventions that boost feelings of connection via online platforms are likely to not only enhance the positive outcomes of the therapeutic intervention but also increase user engagement and intervention adherence, which enhances the overall effectiveness of such (Kelders, 2019). Further, any positive feedback individuals receive from others on the site (e.g., likes, shares, positive comments) can boost positive affect and feelings of social support and validation (Carr, Wohn, & Hayes, 2016; Wohn, Carr, & Hayes, 2016), which may in turn both enhance and validate meaningful experiences.

A meaning-making photo-ethnographic intervention

Given our desire to find an effective intervention strategy that could be applied widely, without cost, and regardless of geographical location, we were influenced by past work that used positive psychology interventions (PPIs). These PPIs are generally straight-forward, independently-conducted exercises that participants complete for a certain duration of time, and that focus on some sort of positive skill or habit (e.g., Lyubomirsky, 2008; Seligman, 2004; Seligman et al. 2005). Research exploring the efficacy of such interventions has found positive improvements for things like positive affect, life satisfaction, and optimism (Dickens, 2017; Sin & Lyubomirsky, 2009).

Work by Steger et al. (2014) began investigating the benefits of using photography to discover the meaning in one's life (which they referred to as photo-ethnography). The idea here is that if people consciously explore and think about meaningful experiences in their everyday lives (and are instructed to do so using photos as a means of capturing instances or examples of meaning), perhaps that would boost feelings of meaning, and other measures of wellbeing, over time. With a digital camera provided by the research team, they had participants take a number of photos during the week, which they thought reflected elements of meaning from their lives (DeBerry-Spence et al., 2019; van Zyl, Hulshof, et al., 2019). At the end of the week, they had to look at their photos and write about why each photo was particularly meaningful to them. Results from pre- to post-intervention showed increases in self-reports for the presence of meaning in life and satisfaction with life, but a marginal decrease in the search for meaning in life. Measures of depression and anxiety decreased; however, stress showed no changes.

That said, the pilot study by Steger and colleagues (2014) showed promise but could be expanded in several positive ways. First, we wanted a more diverse sample, beyond undergraduate university students. Secondly, we believed that by using participants' smart phones and/or personal internet access, we could make taking photos a simple and cost-free practice, as participants already had the tools necessary for photo-ethnography, and in fact almost always had such tools at their immediate disposal (van Zyl, Hulshof, et al., 2019). This also meant our participants never needed to come into the lab for any reason, as they could engage with all elements of the intervention online. Thirdly, we thought that by having participants take photos and think about what makes those photos meaningful in the moment, this daily dose of reflections on meaning (and perhaps gratitude) might be somewhat more impactful repeated over the course of the week than simply one thoughtful session at the end. Similar to the "three good things" gratitude intervention (Emmons & McCullough, 2003), we had participants write down three things that made the photo feel meaningful to them. We thought that by using a daily intervention, we could not only get people to think about meaning in life, but to also become more cognisant of their appreciation for life elements. By engaging in such practice each day, they also get more used to engaging in such mindful reflection, which might boost feelings of life satisfaction or perhaps reduce feelings of anxiety (Steger et al., 2014). Lastly, we saw benefits in using social media, specifically Instagram, as a platform for sharing these photos with the research team and others. Participants became part of an online community, where they could share meaningful photos with others, along with captions explaining the significance of the photos, and get instant feedback from community members (such as likes and comments).

In line with Steger et al. (2014), it was therefore expected that those who participated in this intervention would report statistically significantly higher in meaning, life satisfaction and gratitude between the first and second measurement. It was further anticipated that directly after the intervention, participants would report lower levels of stress, depression and anxiety. It was expected that respondents would report higher levels on presence of meaning, life satisfaction and gratitude over a 3-month and 12-month period. Similarly, it was expected that

stress, depression and anxiety would be reported at lower levels across time, but the full extent towards which was not known. Additionally, some form of a return to baseline levels of the treatment variables was expected over time, based on the hedonic treadmill framework of Brickman and Campbell (1971).

The current study

The purpose of this study was to develop and evaluate a brief online photographic meaningful moments intervention aimed at enhancing wellbeing through Instagram. A 4×1 treatment-only intervention design was used to assess the immediate-, medium- and long-term changes in wellbeing (meaning, gratitude, life satisfaction) and common mental health problems (depression/stress/anxiety). This study builds upon the pilot study of Steger et al. (2014) through not only looking at the immediate-, medium-, and long-term efficacy of the intervention, but also employing social media (Instagram) as an intervention platform.

Bayesian analysis

In the current study, a Bayesian approach to latent growth modelling was adopted. By using informative prior distributions, one could actively incorporate the results by Steger et al. (2014) into the analyses. In this manner, the impact of study-specific data artefacts on the final results diminishes. Moreover, we do not simply repeat tests, but we let the information and evidence accumulate.

Methods

Research design

A pre-experimental longitudinal intervention design was employed to investigate the effectiveness of the intervention over a 12-month method. *Quantitatively*, 4 measurements $\times$ 1 treatment group design, employing an online psychometric assessment methodology, was used to assess changes in the study variables over time. A psychometric test battery—consisting of instruments measuring meaning (search for and experience of), life satisfaction, gratitude, as well as depression, stress and anxiety—was administered a week before, directly after-, 3 months after and 1 year after the completion of the intervention.

Research procedure

A non-probability, self-sampling (volunteer) strategy was employed to gather participants for this study. A repeated measures power analysis was conducted with G*Power (Mayr et al., 2007) in order to determine the appropriate sample size before the sampling procedure was initiated. The results revealed that with a desired effect size in our outcome measures of 0.60, an α level of 0.05, and a power level of 0.95, that there is a 95% chance to reject the null hypotheses with a total number of 47 respondents. Therefore, to account for natural attrition, a sample size of 55 was pursued.

After the sample size was determined, specific inclusion and exclusion criteria was developed to inform the recruitment and participation process. In order to be *included or eligible* to participate in the intervention study, participants needed to (b) be between the ages of 18 and 65, (b) be proficient in English, (c) be proficiently able to use technology, and (d) have access to a smartphone with a camera and an active internet connection.

Several factors also contributed to the *exclusion* of individuals in the study. Individuals who did not have a smartphone, who were not proficient in English, who showed below average levels of technological competence, and those who self-reported with high levels of depression/stress/anxiety were excluded from the study. Once these criteria were set, the recruitment process was initiated.

Recruitment process

Figure 1 presents an overview of the study design and recruitment process. Candidates were recruited through various social-media platforms (e.g. Facebook, Instagram, Twitter and Reddit) and email. An invitation flyer was developed that invited candidates to participate in the study. The flyer was distributed through the aforementioned channels. Embedded in the flyer image was an URL which directed candidates to an online registration site. Here, the entire intervention procedure was explained, the ethical considerations discussed (e.g. voluntary participation, right to confidentiality, the right to withdraw, the right to anonymity, etc), and the way in which the assessments would take place. If candidates were interested in participating, they could register on the site, which captured basic contact information. The recruitment process lasted approximately four weeks (between the 28 February 2018 and the 29 March 2018). Initially, *220 individuals* signed up to participate in the study.

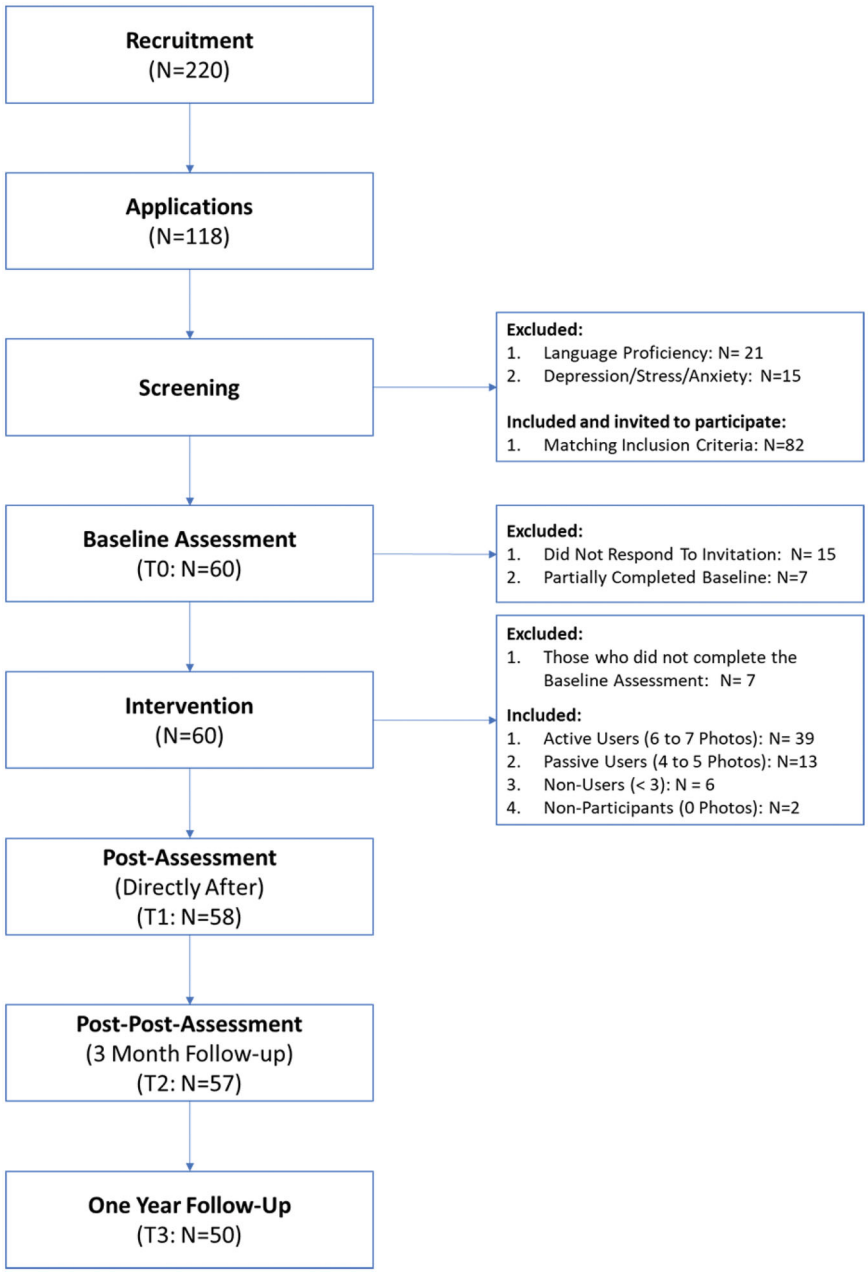

Figure 1. Study design flowchart.

Three weeks before the launch of the intervention, participants were sent a link via email requesting the completion of a battery of psychometric assessments. In this email, the rights and responsibilities of the participants were again discussed, and participants needed to agree to the terms-and-conditions of participation before they were directed towards the completion of the baseline assessment. A reminder email was sent three days before the pre-assessment closed. A total number of *118 individuals* completed the pre-assessment (baseline).

After the pre-assessment, participant responses were screened for eligibility based on the inclusion and exclusion criteria. Thirty-six individuals' applications were declined. In total, *82 individuals* were then invited to participate in the intervention, of which *60 individuals* completed the first assessment (T0).

Selected participants were then sent thorough instructions on how to create a new Instagram account, how to post pictures, how to follow #hashtags and what would be expected of them during and after the intervention. The researchers' set up both a dedicated email account and a dedicated Instagram account that participants could contact should they experience difficulties with registering the Instagram account or if they had questions about the process. A

week was allotted to creating the Instagram account. Three days before the start of the intervention, thorough instructions of the intervention were emailed to the participants.

The intervention started on a Monday and lasted seven days to keep in line with Steger et al.'s (2014) original intervention protocol. Directly after the intervention, the post-assessment was emailed to participants requesting the completion of the second psychometric assessment tests battery. This assessment also included an open-ended question requesting a summary of what they believed their three primary sources of meaning were. Two reminder emails were sent requesting individuals to complete the assessments. During this time, all photos and qualitative personal reflections posted on Instagram were captured and coded. A total number of *58 participants* completed the second assessment.

Three months after the intervention, participants were sent another email with a link to the psychometric assessments. Initially, *53 participants* completed the third survey within the allotted time frame (1 week). However, four participants completed the questionnaires 2 weeks after the final due date. These were not included in the preliminary analyses but were later included in the final dataset. Therefore, a total number of *57 participants* completed the assessments at Time 2 (T2). Finally, exactly 1 year after the completion of the intervention, participants were sent a final link which directed participants to complete the final assessment battery. The final measurement was completed by 50 participants (T3). All the quantitative data was captured and stored on a secure SQL server.

Participants

Table 1 provides an overview of the characteristics of the active participants ($n = 58$). The majority of the participants were South African (47.2%), Afrikaans speaking (36.2%), married (44.8%) females (82.2%), between the ages of 31 and 40 years (41.4%) who had completed a Masters level of education (43.1%). Most were employed on a full-time basis (69%) and posted between 6 and 7 photos throughout the intervention (67.2%).

Intervention design, treatment conditions and content

Design

This brief positive psychological intervention employed a "self-development" or "self-help" design, where individuals were responsible for their own growth and development. This design is similar to how "self-help books" present activities to readers in an attempt to provide structured guidelines on how to enhance their wellbeing; without therapeutic input or active guidance from a professional (Schueller & Parks, 2012; Sin & Lyubomirsky, 2009; Van Zyl & Rothmann, 2014). The Meaningful-Moments intervention attempted to provide participants with an opportunity to discover and reflect upon the sources of meaning in their lives using a mobile phone and a Photo-Ethnographic procedure. Specifically, it aimed to use mobile phone photography to afford individuals the opportunity to become more cognisant of the sources of meaning and the associative reasons why these sources of meaning were indeed meaningful. Further, it attempted to utilise the power of social media (i.e. Instagram) as a means to both disseminate the intervention, and to create a small social support network that reinforced the practice of sharing meaningful moments (van Zyl, Hulshof, et al., 2019).

Treatment conditions

Therefore the *primary treatment condition* within the study was "*Meaning*" and its underlying components: Presence of Meaning and Search for Meaning (Steger, 2019; Steger et al., 2011). Given meaning's close association to positive life outcomes such as subjective wellbeing and the management of negative moods, *life satisfaction* (Diener et al., 1985) as well as *depression, stress and anxiety* (Antony et al., 1998) were set as *secondary outcomes*. Finally, various authors have argued that gratitude is one of the most important drivers for creating meaning and enhancing wellbeing. Therefore, *gratitude* was employed as an *antecedent* or "activating mechanism" for both meaning and life satisfaction (Bono & Sender, 2018; Rusk et al., 2016; Watkins et al., 2003).

Content

The intervention involved several inter-related components which involved either the participants or researchers.

First, all the invited participants were requested to create an Instagram Account and post a test-image 2 weeks before the start of the intervention. Detailed instructions on how to set up an Instagram account, post images, and follow hashtags were drafted. These instructions were piloted with a small group of individuals prior to dissemination, to ensure that they were clear, detailed and easy to follow. The instructions were amended based on the experiences of the

pilot group. The instructions were then emailed to participants. Further, to ensure that participants were able to use Instagram correctly, they were requested to post a test image after registering the Instagram account. If individuals successfully posted a photo on Instagram, they were eligible for the next phase of the intervention.

Second, participants were emailed instructions of the intervention 3 days prior to the start. These instructions were also pilot tested on a small group of individuals before being disseminated. For the duration of 1 week, participants were requested to look for meaningful moments through the course of each day and capture such via a photograph with their smartphones. These meaningful moments could take any form (a person, a place, an object, an artefact, a relationship, etc), but they needed to be perceived as being meaningful, profoundly powerful or something that "really stood out" during a particular day. In this way, participants constructed their own definition of what they considered to be "meaningful" (rather than being pre-conditioned by a formal definition). At the end of a particular day, participants were instructed to upload the photo to Instagram (with a specific hashtag) and reflect upon what the photo signified, represented or meant. Participants were requested to share three reasons why the given image was subjectively meaningful in the Instagram comment box. Participants were also requested to follow other users participating in the intervention and to comment, like and reflect upon their photos. This process was to be repeated for 6 days. On the seventh day, participants were instructed to compile an electronic collage of all six photos uploaded during the week and to reflect upon and post the three most frequently occurring themes or "primary sources of meaning" evident in these photos.

Finally, to simulate the social media experience, the researchers interacted with the posts throughout the course of the week. The researchers "liked" and "commented" on each of the participants' photos. An "interaction protocol" was developed and agreed upon between the researchers before the start of the intervention. This protocol stipulated the extent towards which researchers would engage with participants, the time between a participant's post and a response from the researchers (a maximum of 10 min), how inappropriate comments/posts would be managed and the contingency plans to be actioned should the intervention evoke severe negative reactions from participants. The researchers worked in shifts of 8 h to actively monitor and respond to posts as they appeared on Instagram. On Intervention Monday, Wednesday and Friday, the researchers posted a video through Instagram's "Story" function to reinforce the intervention instructions, the procedure, and to share some of the meaningful moments of the previous days. These "Story" posts had two functions: (a) to ensure that participants were following the intervention protocol, and to remind them to post their pictures at the end of the day, and (b) to monitor, through Instagram's "Seen" function, the level of participation. Further, each day a different researcher posted his/her own meaningful moment and personal reflection on the Intervention's Instagram Account.

Measures

Five short instruments were employed to gather data on the biographic information, meaning, life satisfaction, gratitude, depression, stress, and anxiety of the participants.

A *self-developed biographical questionnaire* was used to capture participants' gender, age, marital status, level of education, native language, nationality, country of residence, employment status, self-report general health and English proficiency. A unique tracking code was also developed to track each participant between measurements.

The *Meaning in Life Questionnaire* (MLQ) (Steger et al., 2006) was administered to assess participants' self-reported experiences of Presence of Meaning and the Search for Meaning. The instrument is comprised of 10 items rated on a 7-point Likert type scale ranging from 1 (Absolutely untrue) to 7 (Absolutely True). Examples of items are "I have a good sense of what makes my life meaningful" (Presence of Meaning) and "I am always searching for something that makes my life feel significant" (Search for Meaning). The instrument has shown to be reliable in various contexts with Cronbach Alpha's ranging from 0.83 to 0.91 for both subscales (Steger et al., 2006, 2014).

The *Gratitude, Resentment and Appreciation Scale* (GRAT) (Watkins et al., 2003) was used to measure participants' overall level of gratitude. The instrument measures participants' Lack of a Sense of Deprivation (LOSD), Simple Appreciation (SA) and Appreciation for Others (AO) on a 9 Point Likert type scale ranging from 1 (Strongly Disagree) to 9 (Strongly Agree). LOSD was measured by items like "Life has been good to me", SA by items such as "Oftentimes I have been overwhelmed at the beauty of nature," and AO by items like "I feel deeply appreciative for the things others have done for me in my life." Across samples

this instrument has shown to be reliable with Cronbach Alphas ranging from 0.88 to 0.94 on the various subscales (Watkins et al., 2003).

The *Depression, Anxiety and Stress Scale* (DASS-21) (Antony et al., 1998) was employed to measure state-like depression, anxiety and stress. The instrument consists of 21 self-report items, rated on a 4 point Likert-type scale ranging from 0 (Did not apply to me at all) to 3 (Applied to me very much, or most of the time), where participants needed to reflect upon depressive, anxious and stressful experiences of the last week. Examples of items include: "I found it hard to wind down "(Stress), "I found it difficult to work up the initiative to do things" (Depression), and "I was worried about situations in which I might panic and make a fool of myself" (Anxiety). In previous studies it has shown to be a reliable measure with Cronbach Alphas ranging from 0.89 to 0.93 on the various subscales (Teo et al., 2019).

The *Satisfaction with Life Scale* (SWLS) (Diener et al., 1985) was employed to measure subjective well-being or "hedonic happiness". The instrument measures overall life satisfaction of individuals based on a 7-Point Likert type scale ranging from 1 (strongly disagree) to 7 (strongly agree). It is comprised of items such as "I am satisfied with my life." The instrument has shown high levels of internal consistency with Cronbach Alphas ranging from 0.82 to 0.94 (Diener et al., 1985; Steger et al., 2014).

Statistical analysis

Data was processed sequentially with IBM's SPSS v. 25 (IBM, 2019) and Mplus v. 8.3 (Muthén & Muthén, 2019). *First*, descriptive statistics (i.t.o. means, standard deviations, skewness and kurtosis) and Cronbach Alpha's were computed in order to determine the distribution of the data and to determine the level of internal consistency of the measures for each time stamp. To determine normality, skewness or kurtosis should not exceed +2 or −2. The level of internal consistency for Cronbach Alpha's was set at >0.70 (Nunnally & Bernstein, 1994).

Second, an unconditional Bayesian level and shape latent growth curve modelling (BLGM) approach was employed to determine growth trajectories and rate of change in the variables over the four time points. The level and shape model does not enforce a linear slope, but estimates development between time points by fixing only two factor loadings at 0 and 1 respectively, and freely estimating all others. The mean of the shape factor represents the rate of change between the timepoints for which the factor loadings are 0 and 1. The level factor mean represents the initial value of the variable in question (Lee & Song, 2012). The covariance between the level and shape factors for each of the variables was freely estimated. To establish model fit within the Bayesian framework, the posterior predictive *p*-value (PP*p*), Root Mean Square Error of Approximation Index (RMSEA) and CFI were used. Good fit is indicated by a PPp value close to .50, RMSEA < .08, and CFI > .90.

To promote estimation of the model, we used the differences between the pre- and post-intervention measurements from Steger et al. (2014) as our prior information for the shape parameter in the MLQ, DASS-21 and SWLS models. In our models, the shape parameter also represented the pre- post-intervention difference, as we set the factor loading for Time 2 (Post-Test) at 1. For the shape parameter we used a normal prior distribution with the mean difference from Steger et al. (2014) as its mean, and the squared standard error as its variance per dependent variable. Specifically: $s_{\text{SearchforMeaning}} \sim N(-0.76,0.17)$, $s_{\text{PresenceofMeaning}} \sim N(1.07,0.15)$, $s_{\text{Stress}} \sim N(0.10,0.07)$, $s_{\text{Depresesion}} \sim N(-0.21,0.05)$, $s_{\text{Anxiety}} \sim \text{N } -0.12,0.04)$, $s_{\text{SatisfactionwithLife}} \sim N(1.37,0.17)$, where s is the shape parameter. As there was no information from the literature available on the other parameters in the level and shape model, Mplus default priors were applied. That is, $N(0,10^{10})$ for the level factor mean and the estimated factor loadings, implying a diffuse prior; inverse gamma with a shape of −1 and scale of 0 for the residual variances, implying an improper uniform prior ranging from minus to plus infinity; inverse Wishart with a zero scale matrix and −3 degrees of freedom for the latent variance-covariance matrix, implying an improper and essentially uniform prior for its elements (Asparouhov & Muthén, 2010).

The default Mplus Markov Chain Monte Carlo (MCMC) Gibbs sampler was used with two chains and 100,000–500,000 iterations, depending on the potential scale reduction (PSR) criterion. As is the default in Mplus software, convergence was established when the PSR factor approached an absolute value of 1 (Brooks & Gelman 1998; Van de Schoot et al., 2014). The first half of the imputed MCMC iterations for each model were used as burn-in indicators, and were therefore discarded (Van de Schoot et al., 2014).

Unstandardised and standardised mean differences (i.e., Cohen's *d*) were computed between baseline and subsequent assessment instances as a measure of effect size. Cohen's *d* was interpreted based on the associated framework (Cohen, 2013) where .2 is the threshold for

a small effect, .5 for a medium effect and .8 for a large effect. Statistical significance was set at $p < 0.01$.

Finally, a sensitivity analyses was conducted to estimate the impact of the priors extracted from Steger et al. (2014). Here, the default diffuse priors estimated by Mplus were used to determine the effect (Muthén & Muthén, 2019), which means that: $s \sim N(0, 10^{10})$ in addition to the default priors as specified earlier. In order to determine which set of models (with or without Steger's priors) fitted the data better, comparative fit (Bayesian Information criterion: BIC & Deviance information criterion: DIC) and absolute fit indices (PP*p*, RMSEA, and CFI) were used as indicators for comparison. The lowest comparative value on these factors indicated better fit.

Results

Descriptive statistics and internal consistency

Table 2 provides a summary of the descriptive statistics (means, standard deviations, skewness, kurtosis) of the factors at the four different time/assessment intervals. The results showed that all instruments showed sufficient levels of internal consistency across all time/assessment intervals ($\alpha > 0.70$; Nunnally & Bernstein, 1994). Further, the data on all factors except Presence of Meaning (1 Year), Simple Appreciation (3 Months), Appreciation of Others (1 Year), Lack of a Sense of Deprivation (Post), Depression (Post) and Anxiety (Pre, Post, 3 Months), were normally distributed.

Bayesian level and shape latent growth modelling with priors

A Bayesian level and shape latent growth model (BLGM) with informative priors was fitted to the data for each of the factors. All models converged well within the specified minimum of 100,000 iterations (*see* Supplementary Materials for the traceplots). The PSR values had a maximum of 1.004 or lower in the last 50,000 iterations in all models. Model fit results

Table 2. Descriptive statistics, and Cronbach Alphas.

	Range	Mean	*SD*	Skewness	Kurtosis	α
Meaning in Life						
Search for Meaning (Pre)	1–7	4.90	1.02	−0.50	−0.13	0.72
Search for Meaning (Post)	1–7	6.28	0.55	−0.54	−0.79	0.71
Search for Meaning (3 Months)	1–7	5.06	1.02	−0.32	−0.07	0.71
Search for Meaning (1 Year)	1–7	5.06	1.20	−0.41	−0.35	0.79
Presence of Meaning (Pre)	1–7	4.64	1.30	−0.28	−0.90	0.88
Presence of Meaning (Post)	1–7	6.14	0.78	−0.63	−0.70	0.81
Presence of Meaning (3 Months)	1–7	5.28	1.23	−0.90	1.02	0.94
Presence of Meaning (1 Year)	1–7	5.35	1.12	−1.40	2.42	0.88
Gratitude						
Simple Appreciation (Pre)	1–9	7.54	1.00	−0.45	0.55	0.76
Simple Appreciation (Post)	1–9	8.43	0.61	−1.22	0.82	0.78
Simple Appreciation (3 Months)	1–9	7.72	1.21	−1.71	3.69	0.85
Simple Appreciation (1 Year)	1–9	7.71	1.06	−0.84	0.62	0.78
Appreciation of Others (Pre)	1–9	6.94	1.29	−0.43	0.21	0.72
Appreciation of Others (Post)	1–9	8.16	0.68	−0.95	0.92	0.71
Appreciation of Others (3 Months)	1–9	7.44	1.13	−0.53	−0.38	0.82
Appreciation of Others (1 Year)	1–9	7.86	0.90	−1.82	6.70	0.82
Lack of a Sense of Deprivation (Pre)	1–9	6.66	1.63	−0.30	−1.10	0.86
Lack of a Sense of Deprivation (Post)	1–9	7.78	1.19	−1.82	6.13	0.88
Lack of a Sense of Deprivation (3 Months)	1–9	7.13	1.37	−0.43	−0.75	0.87
Lack of a Sense of Deprivation (1 Year)	1–9	6.54	1.91	−0.40	−1.23	0.89
Common Mental Health Problems						
Stress (Pre)	0–3	2.05	0.64	0.70	0.12	0.86
Stress (Post)	0–3	1.28	0.36	1.31	1.02	0.78
Stress (3 Months)	0–3	1.77	0.71	1.11	0.77	0.90
Stress (1 Year)	0–3	1.84	0.59	0.75	0.39	0.85
Depression (Pre)	0–3	1.63	0.63	1.15	0.52	0.92
Depression (Post)	0–3	1.14	0.25	1.94	2.95	0.83
Depression (3 Months)	0–3	1.50	0.64	1.49	1.51	0.91
Depression (1 Year)	0–3	1.41	0.42	1.21	1.24	0.87
Anxiety (Pre)	0–3	1.47	0.47	1.90	5.98	0.75
Anxiety (Post)	0–3	1.11	0.20	2.95	9.91	0.70
Anxiety (3 Months)	0–3	1.30	0.54	2.75	7.91	0.86
Anxiety (1 Year)	0–3	1.44	0.50	1.19	0.48	0.81
Life Satisfaction						
Satisfaction with Life (Pre)	1–7	4.79	1.29	−0.48	−0.90	0.88
Satisfaction with Life (Post)	1–7	6.20	0.86	−1.15	0.43	0.92
Satisfaction with Life (3 Months)	1–7	5.23	1.17	−0.52	−0.66	0.90
Satisfaction with Life (1 Year)	1–7	5.37	1.19	−1.22	1.23	0.96

show that PP*p* value was larger than .05 for most models, indicating adequate fit. Only for Stress, Depression and Satisfaction with Life the PP*p*-value was low in combination with a relatively high RMSEA and low CFI. As there are few constraints in this model, insufficient model fit seems best explained by non-normality in the data. While data is normally distributed at T1, at T2 participants tend to improve their scores such, that the data becomes highly skewed towards to positive side of the scale with high kurtosis. Transforming the data would also affect the T1 measure and complicate the interpretation. Therefore, we decided to continue with the current data and models, also when fit was relatively low (Table 3).

The results of the BLGM models for meaning in life, gratitude, common mental health problems and life satisfaction were estimated and summarised in Table 4 and Figures 2–4. The results show that directly after the meaningful moments intervention, participants showed on average significant improvements for all variables, with a large effect size.

Three months later, significant improvements were still present for Presence of Meaning, Appreciation of Others, Lack of a Sense of Deprivation, and Satisfaction with Life. The effect sizes were large, large, medium and medium, respectively.

One year after the intervention, the average Presence of Meaning, Appreciation of Others, Depression and Satisfaction with life scores were more beneficial again than 2 weeks before the intervention. Effect sizes were small for depression and large for all other findings.

Sensitivity analyses on prior distribution sensitivity

To assess the impact of the priors based on Steger et al. (2014), analyses were also conducted by only using the default Mplus priors. In other words, the BLGM process was estimated without using Steger et al.'s (2014) findings as prior indicators for the meaning in life, common mental health problems and life satisfaction. As Steger et al. (2014) did not measure gratitude, no priors for such is present and therefore the model results for the sub-factors of gratitude in the preceding section is retained. First, the model fit statistics were estimated and summarised in Table 5. The results again showed that PP*p* values lower than .05 for Stress, Depression and Satisfaction with Life. PP*p* values for all other factors were closer to .50, indicating acceptable fit.

The results of the sensitivity analysis are shown in Table 6. With the default Mplus priors we found that the results were comparable to those with informative priors. Only for Stress with default priors, the effect remained significant 3 months and 1 year after the intervention, with small effect sizes.

Model comparison: Bayesian LGM with and without Steger's (2014) Priors

To determine which set of models (with or without Steger et al.'s priors) should be retained, a model comparison strategy was employed based on the suggestions of Lee and Song (2012). Here, model fit statistics (BIC, DIC and RMSEA) are used as indicators to discriminate between models. Lower values on the three indicators of comparative fit (BIC, DIC and RMSEA) act as indicators of the best fitting model and will therefore be retained for interpretive purposes.

Table 7 shows the result of the fit statistics with informative priors minus the fit statistics with default priors. For the difference in PP*p*, negative values indicate a preference for the model with default priors, whereas for all other indices, positive values indicate a preference for the model with default priors. All

Table 3. Bayesian latent growth model fit statistics.

Model	Posterior predictive *p*-value	RMSEA	CFI	DIC	BIC	90% CI RMSEA LL	90% CI RMSEA UL
Meaning in Life							
Presence of meaning	0.07	0.18	0.90	615.68	641.77	0.11	0.26
Search for meaning	0.11	0.16	0.85	575.30	601.45	0.07	0.26
Gratitude							
Simple appreciation	0.08	0.18	0.86	578.12	604.04	0.11	0.26
Appreciation of others	0.05	0.19	0.80	607.82	634.25	0.13	0.26
Lack of deprivation	0.50	0.00	1.00	764.93	790.78	0.00	0.18
Common Mental Health Problems							
Stress	<0.01	0.31	0.53	360.18	386.67	0.27	0.37
Depression	0.01	0.24	0.66	265.09	292.11	0.19	0.30
Anxiety	0.35	0.08	0.96	198.10	215.41	0.00	0.20
Life Satisfaction							
Satisfaction with life	<0.01	0.28	0.74	647.19	674.19	0.24	0.34

$\Delta\chi^2$: Difference between χ^2 for data replicated given the posterior and the observed data; RMSEA: Root Mean Square Error of Approximation Index; DIC: Deviance information criterion; BIC: Bayesian Information Criterion; CI: Credibility Interval; LL: Lower Limit; UL: Upper Limit.

Table 4. Bayesian latent growth changes and effect sizes with Steger et al.'s (2014) priors.

	Δ0 m			Δ3 m			Δ12 m		
	M	99% CI	*d*	*M*	99% CI	*d*	*M*	99% CI	*d*
Meaning in Life									
Presence of Meaning	**1.45**	[1.14, 1.76]	2.58	**0.63**	[0.28, 1.01]	1.02	**0.78**	[0.36, 1.21]	1.51
Search for Meaning	**1.26**	[0.97, 1.52]	3.34	0.12	[−0.30, 0.52]	0.31	0.07	[−0.39, 0.51]	0.19
Gratitude									
Simple Appreciation	**0.87**	[0.57, 1.15]	2.05	0.14	[−0.27, 0.54]	0.31	0.22	[−0.19, 0.63]	0.49
Appreciation of Others	**1.19**	[0.81, 1.55]	1.54	**0.59**	[0.21, 0.99]	0.81	**1.08**	[0.67, 1.54]	1.72
Lack of a Sense of Deprivation	**1.08**	[0.56, 1.61]	1.12	**0.51**	[0.13, 0.93]	0.56	−0.03	[−0.49, 0.42]	−0.04
Common Mental Health Problems									
Stress	**−0.69**	[−0.88, −0.47]	−1.99	−0.22	[−0.44, 0.03]	−0.34	−0.26	[−0.52, 0.04]	−0.48
Depression	**−0.46**	[−0.63, −0.29]	−1.20	−0.17	[−0.38, 0.04]	−0.27	**−0.32**	[−0.52, −0.12]	−0.45
Anxiety	**−0.35**	[−0.48, −0.22]	−1.89	−0.14	[−0.34, 0.04]	−0.34	−0.06	[−0.26, 0.13]	−0.16
Life Satisfaction									
Satisfaction with Life	**1.40**	[1.06, 1.73]	2.52	**0.48**	[0.11, 0.85]	0.75	**0.69**	[0.21, 1.16]	1.50

Note. 99% CI: 99% Credible Interval; d: Cohen's d. Bold text indicates a significant difference ($\alpha = .01$) with the baseline assessment two weeks before the intervention.

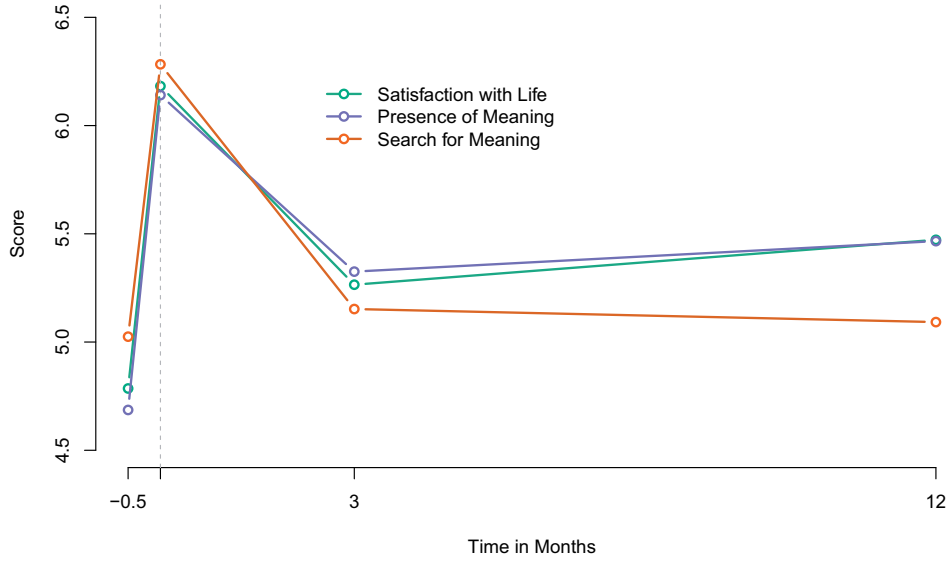

Figure 2. Predicted means for Satisfaction with Life, and Meaning in Life.

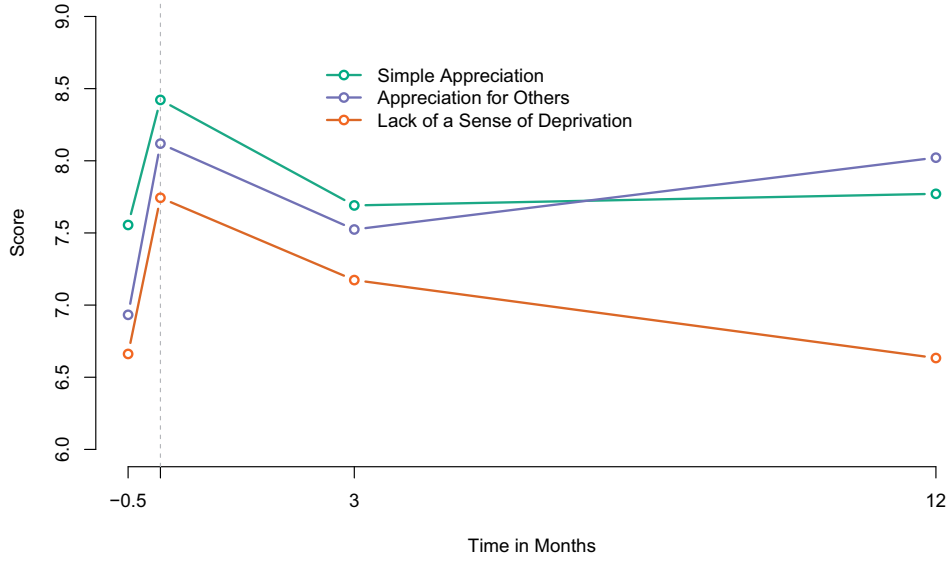

Figure 3. Estimated means for Gratitude with Default Priors.

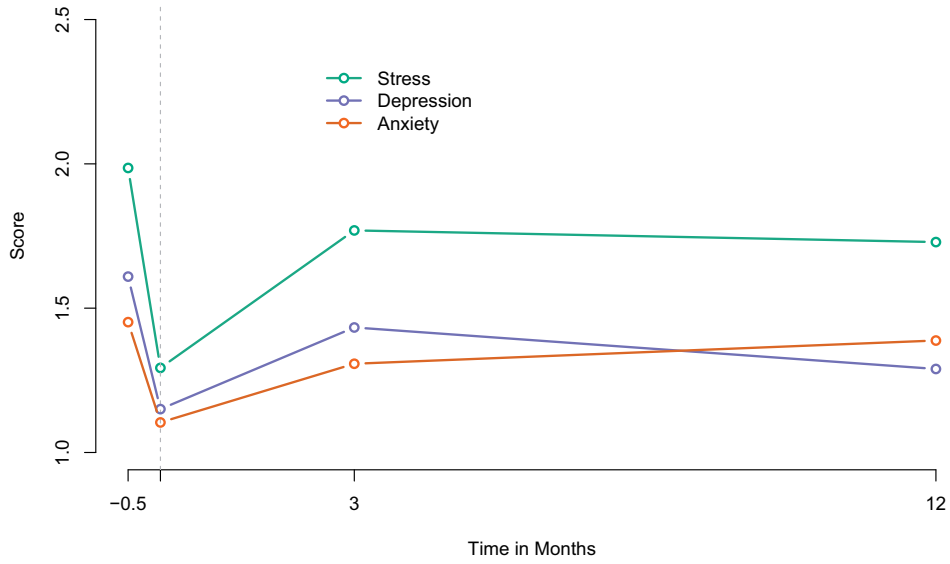

Figure 4. Predicted means for Stress, Depression and Anxiety.

Table 5. Sensitivity analysis.

						90% C.I RMSEA	
Model	Posterior predictive *p*-value	RMSEA	CFI	DIC	BIC	LL	UL
Meaning in Life							
Presence of meaning	0.07	0.18	0.90	615.68	641.60	0.11	0.26
Search for meaning	0.16	0.15	0.88	573.35	599.39	0.04	0.23
Common Mental Health Problems							
Stress	<0.01	0.31	0.55	359.18	385.44	0.28	0.36
Depression	0.01	0.24	0.66	265.11	291.83	0.19	0.30
Anxiety	0.36	0.08	0.96	189.08	215.22	0.00	0.20
Life Satisfaction							
Satisfaction with life	<0.01	0.29	0.73	647.88	674.20	0.25	0.34

Model fit statistics with default Mplus priors.
RMSEA: Root Mean Square Error of Approximation Index; DIC: Deviance information criterion; BIC: Bayesian Information Criterion; CI: Credibility Index; LL: Lower Limit; UL: Upper Limit.

Table 6. Bayesian Latent Growth changes with default priors.

	Δ0m			Δ3m			Δ12m		
	M	99% CI	*d*	*M*	99% CI	*d*	*M*	99% CI	*d*
Meaning in Life									
Presence of Meaning	**1.49**	[1.17, 1.82]	2.64	**0.66**	[0.30, 1.04]	1.02	**0.80**	[0.38, 1.25]	1.56
Search for Meaning	**1.39**	[1.12, 1.66]	1.88	0.22	[−0.19, 0.62]	0.53	0.16	[−0.29, 0.61]	0.44
Gratitude									
Simple Appreciation	**0.87**	[0.57, 1.15]	2.05	0.14	[−0.27, 0.54]	0.31	0.22	[−0.19, 0.63]	0.49
Appreciation of Others	**1.19**	[0.81, 1.55]	1.54	**0.59**	[0.21, 0.99]	0.81	**1.08**	[0.67, 1.54]	1.72
Lack of a Sense of Deprivation	**1.08**	[0.56, 1.61]	1.12	**0.51**	[0.13, 0.93]	0.56	−0.03	[−0.49, 0.42]	−0.04
Common Mental Health Problems									
Stress	**−0.76**	[−0.95, −0.55]	−2.19	**−0.25**	[−0.48, −0.02]	−0.41	**−0.29**	[−0.56, −0.02]	−0.55
Depression	**−0.48**	[−0.67, −0.31]	−1.27	−0.19	[−0.40, 0.03]	−0.29	**−0.33**	[−0.54, −0.13]	−0.48
Anxiety	**−0.36**	[−0.50, −0.23]	−1.95	−0.16	[−0.35, 0.03]	−0.37	−0.08	[−0.28, 0.12]	−0.19
Life Satisfaction									
Satisfaction with Life	**1.40**	[1.04, 1.75]	0.75	**0.48**	[0.11, 0.85]	0.75	**0.69**	[0.21, 1.16]	1.50

Note. 99% CI: 99% Credible Interval; d: Cohen's d. Bold text indicates a significant difference ($\alpha = .01$) with the baseline assessment two weeks before the intervention.

differences, however, are negligible. As a result, a preference for the results with informative or default priors is a matter of personal motivation: some readers may prefer cumulative evidence, whereas others prefer to evaluate each dataset by itself. We will continue to interpret the results with informative priors.

Discussion

The purpose of this paper was to develop and evaluate a brief online photo-ethnographic meaningful-moments intervention aimed at enhancing wellbeing through Instagram. Specifically, the aim was to

Table 7. Model fit difference: models with Steger et al.'s priors—default priors.

Model	ΔPP*p*	ΔRMSEA	ΔCFI	ΔDIC	ΔBIC
Meaning in Life					
Presence of meaning	−0.002	−0.00	−0.00	0.00	0.17
Search for meaning	−0.042	0.02	−0.03	1.94	2.06
Common Mental Health Problems					
Stress	0.000	0.00	−0.02	1.00	1.24
Depression	0.000	−0.00	−0.00	−0.02	0.28
Anxiety	−0.006	0.00	−0.00	0.03	0.19
Life Satisfaction					
Satisfaction with life	0.000	−0.00	0.00	−0.21	−0.01

PP*p*: Posterior predictive *p*-value; RMSEA: Root Mean Square Error of Approximation Index; DIC: Deviance information criterion; BIC: Bayesian Information Criterion.

evaluate the immediate-, medium- and long-term changes in wellbeing (meaning, gratitude, life satisfaction) and common mental health problems (depression/stress/anxiety) of individuals who participated in the intervention. A Bayesian Latent Growth Modelling Approach was employed. The practical effects of the intervention showed diminishing returns over the medium- and long-term. In essence, the results showed the potential of using the intervention to enhance wellbeing and manage common mental health problems in the short-term; with possible implications for enhancing the presence of meaning, appreciation of others and life satisfaction as well as managing depression over the medium- and long-term.

Immediate effects of the intervention

The results showed that *immediately after* the intervention, participants' growth trajectories for meaning in life, gratitude and life satisfaction significantly increased and experiences of common mental health problems all decreased rapidly. This implies that when individuals are encouraged to discover, reflect upon and share the moments in their lives that are meaningful, they may report higher levels of wellbeing and a reduction in immediate feelings of depression, stress and anxiety. When individuals search for—and capture—meaningful moments, they are practicing mindful awareness, which not only increases the experience of meaning, but also enhances the perceptive quality of the associated positive effects thereof (Lyubomirsky, 2008; Van Zyl, Hulshof, et al., 2019). Further, when individuals reflect upon the underlying reasons why these moments are meaningful, and share such on Instagram, it may (a) aid in reliving the past positive experience (Nugent et al., 2011), (b) facilitate the development of a deeper level of self-insight into the sources of one's meaning (Shapiro & Carlson, 2017) and (c) reinforce the search and reflection behaviours through likes and comments (Van Zyl, Hulshof, et al., 2019). Sharing moments/reflections on Instagram may afford others the opportunity to share in the experience, as well as provide one with more clarity on the underlying sources of meaning through active engagement from one's peers. This allows individuals to pursue these sources of meaning in the future when they may need to replenish their energy, or recover from current setbacks (Van Zyl, Hulshof, et al., 2019). In return, individuals may show an appreciation for both the sources of their meaning, as well as having the ability and opportunity to access such (Disabato et al., 2017). These findings partially replicate those of Steger et al. (2014), who also reported that the offline version of the intervention increased meaning in life (both the presence and search for meaning) and life satisfaction for participants in the short-term.

In contrast, the current study found that depression, stress and anxiety statistically significantly decreased directly after the intervention, where Steger et al. (2014) were not able to produce the same result. The difference may be attributable to the two modifications made to the intervention of this study. *First*, where Steger et al. (2014) facilitated a single group orientated self-reflection session at the end of the intervention, our intervention employed the same reflective practice but on daily basis. Active self-reflection is a skill which can be developed but requires continuous deliberate practice to master (Thwaites et al., 2017). One session may not be sufficient to both learn and master active self-reflection, and therefore the extended benefits which it may yield is limited (Hayes & Van Zyl, 2019). Affording individuals multiple opportunities to practice active self-reflection in a week may enhance quality of the skill, as well as the level of insight which could be derived through its practice (Nemec et al., 2017).

Second, our intervention incorporated a social support element using Instagram. The benefits of social support to manage depression, stress and anxiety as well as to enhance mental health are well documented within the literature (c.f. Taylor, 2011 for a review). When individuals post meaningful moments on Instagram, it may create an opportunity for peers to both support and celebrate the associated experiences. It may lead to an increase in social contact with others, as well as provide access to information, advice, guidance, warmth, nurturance, and reassurance in troubling times (Taylor, 2011). Interactions on each post may also reinforce or create a perception that social resources are available should they be

required later. Research shows that the mere perception of the availability of social or emotional support through social media may enhance wellbeing and aid one in managing common mental health problems (Chen & Li, 2017; Valentine et al., 2019). Further, in a review on the effectiveness of social media mental health interventions, Santesteban-Echarri et al. (2018) found specific evidence that social media aids in the reduction of depressive and anxiety symptoms through providing individuals with a means to access informational-, esteem-, network- and emotional support. Specifically, social media also aids in enhancing feelings of thankfulness and appreciation for positive posts and interactions, which in turn reduces experiences of common mental health problems in the short-term (Santesteban-Echarri et al., 2018; Valentine et al., 2019).

Medium and long-term effects of the intervention

The current study further extended the methodological limitations of Steger et al.'s (2014) pilot intervention through investigating the medium- and long-term effects thereof. The results of our study showed that *3 months* after the intervention, participants still reported a positive (yet diminished) rate of change on the presence of meaning, appreciation for others, lack of deprivation and life satisfaction. However, no changes in the search for meaning and appreciation nor depression and anxiety could be observed. *One year* after the intervention participants still reported a positive rate of change for the presence of meaning, appreciation of others, and life satisfaction, as well as a decrease in depression. This implies that those who participated in the study were still able to reap some of the benefits associated with the initial rapid gains reported directly after the completion of the intervention. Although the practice of active reflection and meaning oriented searching behaviour may have stopped directly after the intervention, the awareness and utilisation of factors which were identified during the intervention may have had more sustainable use throughout the assessment period (Steger, 2019).

Study limitations and recommendations

The results of this study are expected to impact the future direction of how brief positive psychological interventions and visually driven developmental methodologies can be scaled and channelled through social media. Although this is merely a small-scale pilot study, it provides researchers and practitioners with a detailed, step-by-step intervention guideline for implementing meaning-focussed photo-ethnographic interventions through social media. It is hoped that both researchers and practitioners will discover the potential power of employing social media in positive psychological interventions. Through initiating similar studies, both the positive- and negative consequences of social media driven interventions can be discovered, refined, and addressed.

Despite the potential implications of this study, it is not without its limitations. First, during the launch of the intervention, the Facebook-Cambridge Analytica Data Scandal made world-wide headlines (Kozlowska, 2018). Facebook (who also owns Instagram) illegally sold personal, and private data of its users to a third party without its users' consent. We received several e-mails from both potential and selected participants who raised concerns about their private data being sold by Facebook to third parties. This may have made participants hesitant or even aversive to the use of social media and could explain the large dropout and non-response rate of participants.

Second, given that participation was on a voluntary basis, and that a non-probability sampling strategy was employed, self-selection bias cannot be ruled out (van Zyl, Efendic, et al., 2019). The nature of the intervention and how it was positioned may have caused individuals with certain traits, needs or characteristics to be naturally drawn to participate; and may have led those who may need such an intervention perhaps not to (Ziliak & McCloskey, 2008). Further, we also did not assess person-activity fit, nor could we conduct an intention-to-treat analysis (van Zyl, Efendic, et al., 2019). Therefore, the findings and the generalisability of this research is isolated to the current sample.

Third, although it was our intention to simulate a real-world intervention, with relatively normal people, under natural conditions, the intervention design posed further limitations. A single group pre-experimental mixed method longitudinal design was employed. This makes the generalisability of the findings outside of the current context impossible.

Fourth, the report of Steger et al. (2014) on the repeated measures ANOVA is quite brief. It is not clear how outliers were dealt with and if the dependent variables actually followed a normal distribution. Consequently, our prior distributions may be a suboptimal representation of the 'historical evidence'. Elaborate method sections or supplementary materials would greatly benefit the use of Bayesian statistics to build cumulative knowledge.

Fifth, seeing that the social media experience was stimulated by an online community with similar interests and intents, through liking and commenting on posts, the absence of such in real-world scenarios may lead to different or even negative consequences for individuals. Social comparison between participants relating to the amount of likes/comments received, could negatively affect participants and counteract the positive effect which social media could have provided. Caution needs to be taken when attempting to implement a similar intervention if a clear online social support network is not in place, or not visible.

Finally, it is important for practitioners to ensure that the intervention is implemented in a controlled, ethical and clinically functional environment. Although social media is used as a dissemination platform, practitioners need to remember that the intervention is a therapeutic psychological act that is aimed at altering clients' behaviour. Practitioners therefore need to ensure adherence to professional ethical codes and local legislation before considering the use of this intervention.

Conclusion

Taken together, the results showed that the practice of becoming mindfully aware of meaningful moments as they occur, reflecting on the underlying reasons as to why such may be considered meaningful, and sharing such in a structured way on Instagram may have significant immediate and long-term benefits for the individual. However, when considering the medium- and long-term effects thereof, it is clear that when the practice of mindful awareness on meaningful moments and self-reflection is not sustained, some important psychological processes like the search for meaning, appreciation and anxiety may return to near baseline levels.

Author contributions

All authors contributed equally to the development, design and execution of the project as well as writing and revising the manuscript.

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The authors declare that there was no conflict of interest in either the development and execution of the current study.

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