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Review

How imagining personal future scenarios influences affect: Systematic review and meta-analysis

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HIGHLIGHTS

- Instructed positive personal future imagination boosts positive affect.
- Future worry increases negative affect equally in high-anxious and low-anxious individuals.
- Imagining the future evokes stronger affect than remembering the past.
- Magnitude of effects depends on how an imagination is applied.
- Future research needs to focus more on clinical application of future imagination.

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ABSTRACT

Imagining the future is a fundamental human capacity that occupies a large part of people's waking time and impacts their affective well-being. In this meta-analysis, we examined the effect of (1) positive future imagination and (2) negative future imagination on affect, and (3) compared the affective responses between imagining the future and remembering the past; lastly, we (4) examined potential moderating variables in this regard. We identified 63 experimental studies (N = 6813) from different research areas and combined studies that applied the best possible self imagination task, future worry induction, and episodic future simulation, respectively. Findings yielded that imagining the future has a moderate to strong impact on affect, and it has a stronger influence on affect compared to remembering the past. Relevant moderator variables in each research area were also identified. We discuss the findings for the field of psychology in general and clinical psychology in particular. More elaborate research on personal future imagination seems crucial for the further advancement of clinical applications for mental health complaints. We conclude with recommendations for future research on the impact of future imagination on affective well-being.

1. Introduction

What people feel and think in the present is often shaped by how they view their personal future. Future thought is seen as a fundamental and distinct human capacity (Atance & O'Neill, 2001; ⁎Gilbert & Wilson, 2007; Suddendorf & Corballis, 2007), taking up about one third of our waking time, whether we are consciously planning or unconsciously mind wandering (Baird, Smallwood, & Schooler, 2011; D'Argembeau, Renaud, & van der Linden, 2011; Killingsworth & Gilbert, 2010; Singer, 1966). For the human species, imagining a potential future might be crucial for survival because it serves various functions: By previewing upcoming positive or negative events and their potential consequences, individuals are able to pre*feel* the impact such situations might have on their lives (with moderate accuracy, see Ayton, Pott, & Elwakili, 2007; Wilson & Gilbert, 2003) and consider preparing for the future events accordingly. For example, future thought allows humans the ability to prefeel how life might become more difficult during the coming winter months, allowing them to prepare (mentally and physically) for a potentially hard time. Further, future thought enables them to prefeel the relief they will experience when summer eventually start again, providing them hope during the winter that the difficult times will not last forever.

Future thought may be related to the immediate future such as expecting what will happen in the next five minutes, but the temporal distance of future events can also range up to many years from now and depends on the level of consciousness, the valence of the imagined

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event or how instructions are framed (*Cole & Berntsen, 2016; D'Argembeau et al., 2011; D'Argembeau, Xue, Lu, van der Linden, & Bechara, 2008). The affective response associated with envisioning personal future events can emotionally charge the representation of people's personalized goals, hopes and fears, also called *possible selves* (Markus & Nurius, 1986; Markus & Ruvolo, 1989). Possible selves can serve as a comparison standard for current self-assessment (Hoyle & Sherrill, 2006; McMillan, Kaufman, & Singer, 2013); specifically, they can inform individuals about discrepancies between their current state and their goals and can increase people's motivation to work towards achieving pleasant (or avoiding unpleasant) states (described in detail in the self-regulation literature: Bandura, 1982; Carver & Scheier, 1990; Gollwitzer, 1999; Higgins, 1987; Mischel, Shoda, & Rodriguez, 1989; Taylor, Neter, & Wayment, 2016). At any of these self-regulatory stages, affect can serve as both a momentary heuristic for subsequent judgements and behaviours (Higgins, Shah, & Friedman, 1997; Schwarz, 2012) as well as represent people's broader and more general goal of striving for positive affective well-being, defined as high positive affect (PA) and low negative affect (NA; Diener, Oishi, & Lucas, 2003; Diener, Suh, Lucas, & Smith, 1999). Going back to the winter example, if people fear the adversities they will face from being exposed to cold and hunger during the upcoming winter, they might be motivated to store provisions and firewood.

Currently, much research aims to better understand self-regulatory processes to help people attain their goals and, therefore, support their affective well-being (Perugini & Bagozzi, 2001; Ryan & Deci, 2000; Sheldon & Elliot, 1999). Consequently, the current literature mostly conceptualizes affect as being only a proxy for motivation or behavioural intentions (Bechara & Damasio, 2005; Muraven & Baumeister, 2000). However, the overarching Western assumption that attaining a goal (e.g., getting married, getting a promotion, or winning the lottery) will promote individual well-being neglects the finding that people's affective well-being adapts relatively quickly to new circumstances (a phenomenon known as "hedonic treadmill", Brickman & Campbell, 1971; see Luhmann, Hofmann, Eid, & Lucas, 2012 for a critical review). Thus, instead of focusing on how well-being is influenced by attaining a goal, more research is needed on how well-being is influenced by *imagining* a goal, since in daily life, imagining the future may influence people's affect more directly. Using the winter example from above, hoping for an early summer while suffering from winter's cold might help people get through this difficult time by simply upregulating their affect. Further, if the long-awaited summer comes later than expected while winter's adversity continues, people's ongoing striving for a better future might actually infuse their everyday work with meaning, because it can help them feel connected to their major motives and recall their core values, providing people the opportunity to constantly reconsider and reduce goal conflicts (D'Argembeau & Mathy, 2011; Lyubomirsky, Sousa, & Dickerhoof, 2006; Vasquez & Buehler, 2007). Thus, to better understand people's affective well-being in daily life, it is important to directly examine people's affective response upon imagining their personal future. Therefore, in our meta-analysis we focused on research examining the magnitude of present affect and relevant moderators when people imagining their personal future.

Different research traditions have approached the concept of future imagination using different methodologies and terminology, so the studies from different fields are only loosely connected. Research in positive psychology has examined processes and conditions that boost and maintain people's well-being (Seligman, Steen, Park, & Peterson, 2005; Sin & Lyubomirsky, 2009). A prominent future-directed account is the *best possible self* imagination task, designed by *King (2001) where participants are instructed to write and imagine their future life, where "everything has gone as well as it possibly could". Various studies adopting this task have empirically shown that it has positive effects on optimism (*Meevissen, Peters, & Alberts, 2011; *Peters, Vieler, & Lautenbacher, 2016), pain management (*Boselie, Vancleef, Smeets, & Peters, 2014; *Hanssen, Peters, Vlaeyen, Meevissen, & Vancleef, 2013), objective health-parameters (*Harrist, Carlozzi, McGovern, & Harrist, 2007; *King, 2001) and on both cognitive (i.e. satisfaction) and affective well-being (Lopes, da Palma, Garcia, & Gomes, 2016; *Lyubomirsky, Dickerhoof, Boehm, & Sheldon, 2011).

Research in clinical psychology has examined how future imagination appears in depressed and anxious populations as compared to healthy groups (MacLeod, 1996; MacLeod & Salaminiou, 2001; Morina, Deeprose, Pusowski, Schmid, & Holmes, 2011; Stöber, 2000). A particular emphasis in this research has been on how pathological worry arises and is maintained across emotional and anxiety disorders (Borkovec, Lyonfields, Wiser, & Deihl, 1993; McEvoy, Watson, Watkins, & Nathan, 2013; Stöber, 1998), specifically in generalized anxiety disorder (Behar, DiMarco, Hekler, Mohlman, & Staples, 2009; Borkovec, Alcaine, & Behar, 2004; Dugas, Letarte, Rhéaume, Freeston, & Ladouceur, 1995; Newman & Llera, 2011; Wells, 1995). Different theoretical accounts highlight that in anxiety disorders worry may function to avoid internal affective experiences through a verbal rather than an imagery-based thinking style (Borkovec et al., 2004; Hirsch & Mathews, 2012; Stöber & Borkovec, 2002). It is proposed that a verbal thinking style may attenuate negative affect in short-term, but will maintain anxiety over the long term (Borkovec & Roemer, 1995; Hirsch & Holmes, 2007; Newman & Llera, 2011; Wells, 1995). In general, worry is defined—unlike other forms of negative, repetitive and abstract thinking, such as past-directed rumination (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008) —by rehearsal of feared scenarios in the future (Borkovec et al., 2004). However, early experimental instructions were phrased more generic ("worry in your usual way", first in Borkovec, Robinson, Pruzinsky, & DePree, 1983) and led to a high amount (70%) of present or past-related thinking, as content analyses showed (Molina, Borkovec, Peasley, & Person, 1998). Thus, more recent experimental paradigms maximized internal validity by specifically targeting future worry: participants were trained in a worrisome thinking style and subsequently instructed to apply this to individual meaningful worry topics in the future (*Stokes & Hirsch, 2010) or a stressful future situation, for example, an impromptu speech (*Wong & Moulds, 2011). However, much knowledge about future worry is derived from early experiments that had included past and present negative thinking; hence, it seems reasonable to review the magnitude and relevant contextual factors of affect in experiments that focus on future worry.

Somewhat different from research on future thinking in positive psychology and clinical psychology, research on episodic future thinking (Atance & O'Neill, 2001) investigates how past experiences are remembered and recombined to construct future events (Schacter, 2012; Schacter, Addis, & Buckner, 2007; Szpunar, 2010). Findings suggest that both remembering and imagining rely on the same cognitive and neuronal processes (Schacter et al., 2012; Schacter, Benoit, & Szpunar, 2017). In studies with different age groups and different experimental paradigms where participants were instructed to imagine ("simulate") the future and remember the past, close similarities were found regarding the amount of recalled episodic and semantic details (Abram, Picard, Navarro, & Piolino, 2014) and phenomenological characteristics (D'Argembeau & van der Linden, 2004; Szpunar & McDermott, 2008). More recent studies in this area have expanded their focus to examine counterfactual events, defined as alternative versions of past episodes that could have happened but did not actually occur (De Brigard, Addis, Ford, Schacter, & Giovanello, 2013; *De Brigard & Giovanello, 2012). Although research has found that a more vivid imagination is related to a stronger affective response (D'Argembeau & van der Linden, 2006; Mathews, Ridgeway, & Holmes, 2013) and particularly characterizes past event remembrance (*Berntsen & Bohn, 2010; D'Argembeau & van der Linden, 2004), some studies directly comparing future to past events found that future imagination produced a stronger affective response (*Caruso, Gilbert, & Wilson, 2008; *Rasmussen & Berntsen, 2013). This seems counterintuitive, but it might be explained by the observation that future imagination strongly reflects meaningful life goals and related schemata. An individual's

schematized future images might be particularly prone to both their positive illusions and worst fears and, therefore, may cause a stronger affective response than their autobiographical counterparts. A systematic review on the comparison of affective response to future imagination versus past remembrance may provide clarity on this issue.

In sum, the current meta-analysis aimed to integrate current knowledge from different research fields by estimating the impact of (1) positive future imagination and (2) negative future imagination on affect, (3) comparing affective response between future imagination and past remembrance, and (4) examining potential moderating variables. By this means, the review of the literature aimed at investigating potential research avenues that may deepen our understanding of future imagination and improve promising applications in clinical psychology.

2. Methods

The aims and methods of this meta-analysis were registered with the PROSPERO database (http://www.crd.york.ac.uk/PROSPERO, registration number: CRD42018086363).

2.1. Eligibility criteria

We searched for studies that experimentally manipulated imagination of participants' personal future and then assessed their affective responses. The inclusion criteria were as follows: (1) study participants were explicitly instructed to imagine or simulate their personal future, (2) at least one subsequent measure of affect was applied, (3) either within-subject (i.e., pre-post assessments) or between-subject analyses (comparing an experimental group with a comparison/control group) were conducted, (4) adult study participants (mean age $>$ 17 years), (5) a minimum sample size of five individuals, and (6) peer-reviewed journal articles. To distinguish adequate future imagination tasks from goal setting paradigms or the sole naming of possible future events with less imaginative involvement, experimental instructions were thoroughly scanned for imaginative cue words regarding intensity (e.g., "[consciously] imagine", "simulate", "contemplate on…" vs. "list" and "name") and appropriate duration of the task ("for a few minutes", "take some time", if unclear: $>$ 30s.). Studies were excluded if (1) participants suffered from primary somatic diseases (such as neurodegenerative diseases, cancer, or stroke) or (2) severe psychiatric disorders, i.e., schizophrenia, substance abuse, or a bipolar, eating or personality disorder. We applied these exclusion criteria to account for potential bias derived from cognitive impairment or affective dysfunction commonly associated with these conditions. Studies were also excluded if (3) additional tasks were reported that may have had a confounding impact on our variables of interest, for example, if instructions included past-related sections ("remember similar past events") that could not be distinguished from future imagination tasks (e.g., via separate assessments) or had no clear emphasis on future direction (e.g., "worry in your usual way"). Inclusion criterion 5 (sample size $\geq$5) and exclusion criterion 3 (no confounding tasks) were added during the search process with the aim of reducing threats to internal validity (i.e., criterion 3) and risks of sampling error (i.e., criterion 5, see Lin, 2018). No restrictions for language and year of publication were made.

2.2. Literature search and study selection

We combined future-related terms (e.g. prospect* OR future OR possible OR anticipat*) with terms frequently related to imaginative activities (e.g. imagin* OR simula*, event* OR self). Concepts of future imagination were combined with terms for affect and related cognitive concepts (i.e. well-being, satisfaction). See Box 1 for the full search string. The systematic search was conducted by one author (RE) in the databases PsycINFO and Medline in August 2017, applied to title, abstract and keywords. An additional hand search was independently conducted by the first author (TS) until April 2018, who checked the cited articles in the reference sections and citing articles (using Google Scholar tool) of all included articles, examined the table of content sections of relevant journals, and contacted authors in the field to obtain information about the existence of studies a standard search might have missed. If the search produced an electronic version of an article ahead of print, we checked in 2018 whether the article in question has already appeared in print. After duplicates were removed, the titles and abstracts of all studies were screened and eligible full-text articles were independently examined for inclusion by the first and second authors (TS & RE). Studies were categorized into separate clusters based on the type of imagination task applied. This minimized heterogeneity between the included studies and allowed a quantitative meta-analytic synthesis. Fig. 1 illustrates the selection process.

2.3. Study clusters & characteristics

The systematic search in Medline and PsycINFO resulted in 19,023 hits, and the additional hand search resulted in 517 hits (see Fig. 1). After removing duplicates and screening based on title and abstract, 1608 full-text articles were assessed for eligibility based on the inclusion and exclusion criteria. In total, 77 studies reported in 62 articles were considered eligible and were thoroughly grouped into separate study clusters. The clusters were based on their applied imagination task that derived from distinct theoretical accounts. Studies adopting the best possible self imagination task (*King, 2001) applied the expressive writing paradigm on the concept of a positively valenced self in the future (see the seminal paper by Markus & Nurius, 1986). These studies were therefore grouped together in the *best possible self cluster* (BEST-Cluster, 25 eligible studies). Studies in which participants were instructed to worry about negative future scenarios applied an experimental psychopathology account grounded in Borkovec's cognitive avoidance theory of worry (Borkovec et al., 2004) and related extensions (Hirsch & Mathews, 2012). They were grouped together in the *future worry cluster* (WOR-Cluster, 11 eligible studies). Studies comparing future imagination to past remembrance were rooted in neuropsychological frameworks condensed in the constructive episodic simulation hypothesis (Schacter et al., 2007; Schacter et al., 2012) that linked cognitive and neuronal memory mechanisms to future imagination. The corresponding studies were therefore grouped together in the *past comparison cluster* (PAST-Cluster, 27 eligible studies). Studies of the nine remaining articles were too heterogeneous to compile a separate cluster or allow meta-analysis and therefore were only reviewed narratively. Fig. 1 illustrates the study selection process in detail. Apart from one (German) publication (*Heimes, 2013), all included studies were published in English between 1982 and 2018 (quantitative synthesis 2001–2018).

2.4. Data extraction & quality assessment

Basic study characteristics were coded by the first author, and these characteristics included authors, title, year of publication, population, age, gender, sample size, outcome measures, type of imagination task and experimental group/condition; these were re-examined by the second author. The outcome measure was a priori defined as present affect, commonly measured by the Positive and Negative Affect Schedule (PANAS, state-version, Watson, Clark, & Tellegen, 1988), but we also included other measures of affective response, mood or cognitive representations of affective or emotional states such as life satisfaction (positive) and depression (negative) at pre-, post-, and follow-up assessment. If two or more distinct measures were reported, they were coded respectively. Studies were not included if measures did not directly target individuals' actual emotional states but predictions about future conditions (e.g., predicted affect) or situational characteristics of the respective event (such as event valence). We also coded pre-defined potential moderators with methodical or theoretical relevance found in

Box 1

The following searchterm was applied for title, abstract and keywords in Medline and PsycINFO

((((prospect* OR future OR possible OR anticipat* OR potential* OR desir* OR fear* OR hoped-for) AND (event* OR self OR selves OR expecta* OR state OR fantas* OR scen*)) OR ((outcome OR prospect* OR future OR episodic OR goal OR self OR event OR mental) AND (imagery OR imagin* OR simulat* OR projection*)) OR ((prospect* OR future OR episodic) AND (thinking OR thought OR plan*)) OR ("temporal comparison" OR "ideal self" OR "mental contrast*" OR "mental time travel")) AND ("affect" OR happiness OR "quality of life" OR "well-being" OR satisfaction))

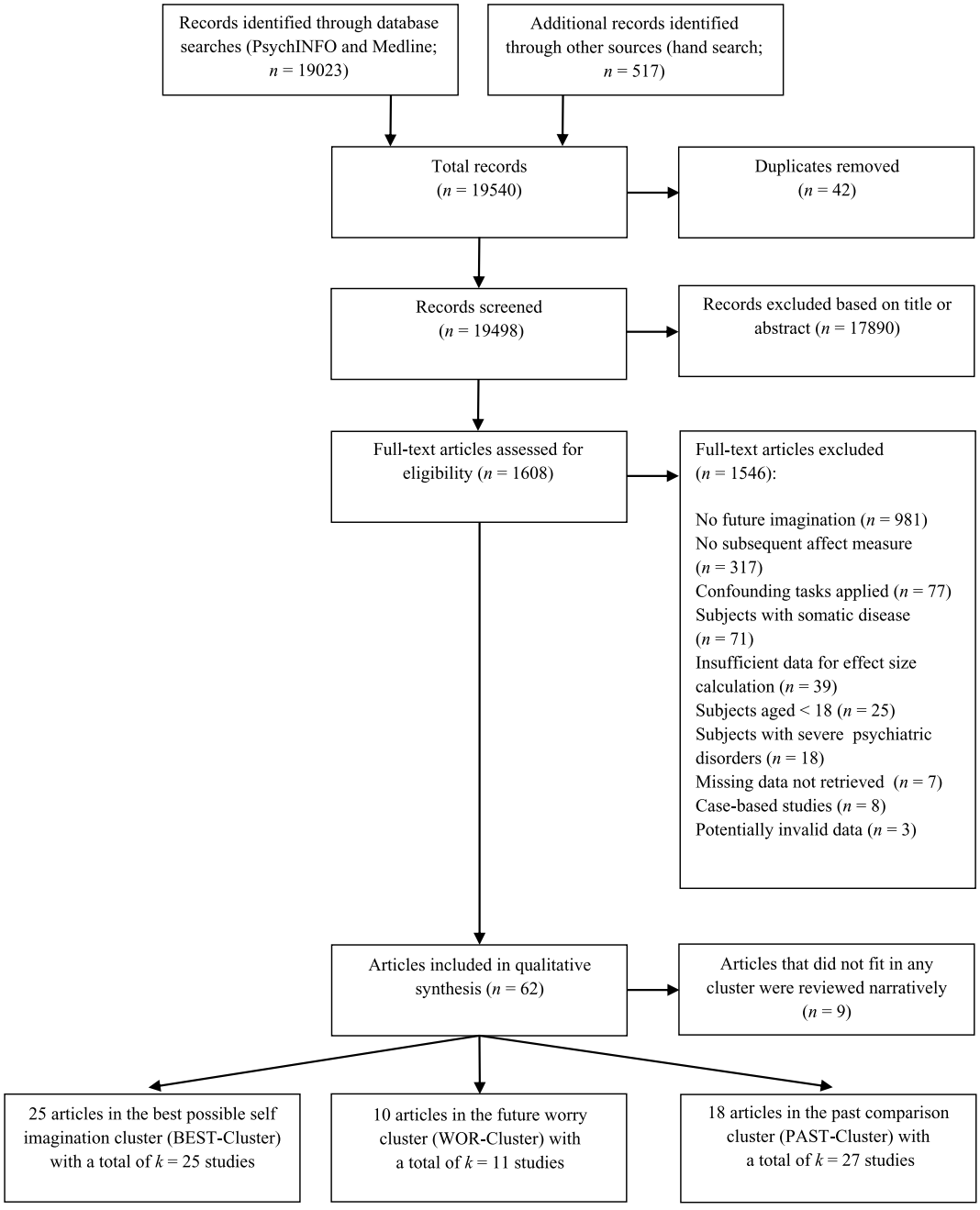

Fig. 1. PRISMA flow chart.

the literature, i.e., randomization, observation period and dosage (Higgins & Green, 2012), application form (writing/imagining; Taylor, Pham, Rivkin, & Armor, 1998), valence, domain (Markus & Nurius, 1986), temporal distance and vividness of imagined event (D'Argembeau & van der Linden, 2004, 2006). A quality assessment scale was developed in advance to detect risks of biases regarding study performance, attrition and reporting. It consisted of five items (rated from 0 (low) to 2 (high) or 3 (excellent quality) and was used to assess quality of affect measurement (0–3), randomization procedure (0–3), as well as quality of reporting of attrition/exclusion (0–2), study sample

(0–2) and imagination task procedure (0–2). If, for example, positive or negative affect was assessed separately via multiple items and its reliability was reported, quality was rated 3 (excellent); if only one emotion or mood item was used, quality was rated 0 (low; see online supplement for the complete quality assessment scale).

Outcome measures, potential moderators and quality assessment items were coded and rated independently by the two first authors, and discrepancies were resolved via discussion. Interrater-reliability across all (metric, ordinal and nominal) moderator and quality assessment items was moderate to excellent (Cohen's Kappa K = 0.77; Fleiss, 1973; Landis & Koch, 1977). Whenever relevant data were missing, authors were contacted and, if necessary, reminded after two weeks. Out of 30 cases of missing data, 19 complete (63%) and one incomplete data sets were provided by study authors, four authors declared to have no access to missing data, and six authors did not reply. If authors did not provide data or if the data could not be estimated from existing data, studies were excluded (a complete list is available in the online supplement).

2.5. Data-analytic plan

All analyses were carried out in RStudio (RStudio Team, 2015), using the metafor package (Viechtbauer, 2010). The data sets and R scripts are accessible on the Open Science Framework's website (OSF; 10.17605/OSF.IO/8MBGU).

2.6. Effect-size calculation and correction

Whenever missing data could not be retrieved from authors, it was, when possible, calculated or estimated based on the given data; standard deviation (*SD*) was calculated from standard error (*SE*) and sample size (*N*), missing *SD* at post-assessment was replaced by *SD* at pre-assessment (not vice versa, Borenstein, Hedges, Higgins, & Rothstein, 2009). If results were reported only for subgroups (i.e., male and female subjects) or subscales, weighted means and *SD*s (accounting for variances of different means, Cooper, Hedges, & Valentine, 2009) were calculated (see online supplement for *M*s and *SD*s of subgroups and subscales). Missing group sizes were estimated from total sample size, assuming an equal distribution across groups (if randomized). Missing reliability coefficients, if no average or minimum reliability was reported, were either derived from instrument validation studies in the respective language area, from other studies using the same instrument or estimated from the literature using similar instruments (applied twice for one-item-scales). If authors only reported effect sizes instead of raw means, those were inserted separately and later included into analyses.

Effect sizes were chosen according to the respective study design applied in each study cluster and differed between the three clusters. When experiments only had one condition in a pre-post design, standardized mean change using raw score standardization (*SMCR*, Morris & DeShon, 2002) was calculated allowing for dependencies between pre- and post-measurements by using a correlation of $r = 0.50$. This relatively conservative estimate was subsequently re-examined by a sensitivity analysis (inserting a high ($r = 0.90$) and a low ($r = 0.30$) correlation) to evaluate its potential impact on effect sizes and therefore uncertainties of results (see WOR-Cluster). When a comparative experimental condition was available, Hedge's *g* was obtained by subtracting their group mean value from the future imagination condition (i.e. future imagination – past remembrance, see PAST-Cluster). When both control group and baseline assessment was conducted, Hedge's *g* was obtained by subtracting standardized pre-post mean differences of the control group from the future imagination group (Morris & DeShon, 2002; see BEST-Cluster).

To account for unreliability of the measures, all effect sizes and their variances were corrected according to their reliability by multiplying them by the factor 1/square root(reliability) and 1/reliability, respectively (Hunter & Schmidt, 2004). For ease of understanding, all results were coded into direction of positive affectivity (and of future orientation in the PAST-Cluster), so that positive effect sizes would indicate a promoted (positive) affect (or stronger impact of future imagination) and negative effect sizes a worsened (negative) affect (or stronger impact of past imagination).

2.7. Meta-analytic strategy

Given the diversity with respect to the experimental designs and assessment of affect, we grouped all eligible studies into separate meaningful clusters according to their respective theoretical accounts. Studies in each cluster needed to be sufficiently homogenous in terms of the applied imagination task and experimental design to allow subsequent meta-analysis.

As we aimed to make unconditional inferences beyond the diverse studies, we ran random-effect models (Cooper et al., 2009). Further, we used multilevel models (van den Noortgate, López-López, Marín-Martínez, & Sánchez-Meca, 2013) to account for dependencies, i.e. by modelling multiple outcomes as nested in multiple samples and samples nested in studies (see WOR- and PAST-Cluster) or modelling multiple outcomes nested in samples (see BEST-Cluster, as only two studies included more than one sample). Robustness of results using SMCR in pre-post change scores were re-examined by running sensitivity analysis inserting high ($r = 0.90$) and low ($r = 0.30$) correlation.

To explain heterogeneity among effect sizes, additional moderator analyses were conducted. Further, τ was calculated separately to obtain an absolute measure of heterogeneity among true values and results were interpreted accordingly. Potential moderators were only selected for analyses if moderator variables provided sufficient variability among each cluster. To detect possible study limitations influencing generalizability of the meta-analytic results, quality assessment items were also included as moderators. An α level of 0.05 was applied for all hypotheses. Risk of publication bias was addressed by visually investigating funnel plots. Trim and fill method was not computed as it does not apply to multilevel models (Duval & Tweedie, 2000).

3. Results

3.1. Study characteristics in the BEST-cluster

The 25 studies in the BEST-Cluster included a total of 3869 participants (72.00% female) with a mean age = 27.51 years. The majority of the studies consisted of student samples, six studies had recruited participants from the general population, and one study sampled patients suffering from fibromyalgia. Publications reported multiple affective outcomes that had been assessed either post-session ($k = 16$), post-intervention (multiple sessions, $k = 15$) or at follow-up ($k = 11$), including positive affect (PA; $k = 23$), negative affect (NA; $k = 20$), life satisfaction ($k = 8$) and depression ($k = 4$). In all but one study, best possible self imagination was conducted by combining writing and imagination, some studies varied different self domains, and two studies added technology-supported components. Most studies ($k = 24$) included an active control group, while the remaining study reported a no-activity control group. Active control groups consisted of imagination tasks (e.g. a typical day or daily activities; $k = 12$), neutral writing tasks (e.g. non-emotional book reviews or to-do-lists; $k = 8$) or consideration of recent events ($k = 4$). Since both pre-post change and control group data were available, effect sizes were obtained from standardized mean differences between change scores of best possible self imagination and control group.

3.2. The impact of best possible self imagination on affect (BEST-cluster)

There was a significant increase in overall-affect in the best possible self imagination groups compared to control groups after one session;

for 16 studies, $g = 0.44$, 95% CI [0.27, 0.61], $p < .001$. Heterogeneity between effect sizes was moderately large ($\tau = 0.36$). For multiple-session interventions in 15 studies, the effect was $g = 0.34$, 95% CI [0.16, 0.52], $p < .001$. Heterogeneity between effect sizes was moderately large ($\tau = 0.31$). Only a marginal significant effect emerged at follow-up assessment for 11 studies, $g = 0.12$, 95% CI [−0.04, 0.28], $p = .08$, and heterogeneity between effect sizes was moderately large ($\tau = 0.21$). Details of these results are shown in Table 2.

These small to moderate effect sizes (Cohen, 1988) indicate that affect was substantially promoted at post-session and post-intervention, but not at follow-up. Since within-study moderators (i.e., dispositional optimism or mindfulness) were diverse between studies and since the studies applied the imagination task with only minor differences, only a few between-study moderators provided sufficient variability to allow moderation analyses. Observation period did not moderate effects at post-intervention ($b = -0.007$, $p = .15$) and follow-up ($b = 0.001$, $p = .90$) and was not accounted for in subsequent models. The effect at post-session was qualified by a moderation of type of outcome, indicating PA to be responsible for the overall effect (PA versus NA: $b = 0.43$, $p < .01$). Type of outcome did not account for variability at post-intervention (but also showed a tendency for stronger influence of PA). Fig. 2 illustrates the effect of the best possible self imagination (after one session) in a forest plot (forest plots of multiple session and follow-up results as well as respective funnel plots of all assessment points are available in the online supplement).

3.3. Study characteristics in the WOR-cluster

The 11 studies in WOR-Cluster included a total of 825 participants (66.50% female) with a mean age of 25.83 years mostly from pre-screened anxious (socially anxious/high worriers) populations ($k = 5$) or from psychologically healthy student ($k = 3$) and mixed/other samples ($k = 3$). Post-session NA scores were assessed by complete NA scales in 6 studies (as measured by the PANAS) while state anxiety was reported in 4 studies, and multiple affect items in one study. Additionally, about half of the publications also reported PA scores ($k = 5$). Roughly half of the studies ($k = 5$) induced worry by letting participants worry on a subsequent impromptu speech while in the remainder ($k = 6$) worry content was an individually chosen worry topic. Four studies manipulated thinking style of worry, i.e. imaginative vs. verbal thinking. Since only three studies included control groups, which were quite heterogeneous between studies (i.e. positive future, past or distraction task) and all studies were limited in experimental length to one-session trials in accordance with ethical considerations, pre-post session change scores rather than between-group scores were calculated to obtain effect-size.

3.4. The impact of future worry on affect (WOR-cluster)

The pre-post change of negative affect (including inversed PA and state anxiety) after a worry session for 11 studies was $SMCR = -0.67$, 95% CI [−1.07, −0.28], $p < .001$. Heterogeneity between effect sizes was large ($\tau = 0.66$). This moderate to large increase of negative affect (Cohen, 1988) indicates a substantial affective worsening during one session of worry. One outlier was detected ($SMCR = -7.45$, *Gould, Gerolimatos, & Edelstein, 2015), but excluding it in the multilevel model did not lead to different results nor high Cook's distance ($D = 0.022$), so it was therefore left in the analyses. A sensitivity analysis consisting of inserting different autocorrelations between pre- and post-measures ($r = 0.30/0.90$) resulted in no substantial change. Hence, moderator analyses were conducted with sufficiently variable moderator variables, and detailed results are shown in Table 2. When an individually meaningful worry topic was chosen, participants reported higher NA (particularly anxiety) than when the worry topic was a subsequent impromptu speech ($b = 0.86$, $p < .01$). Low- and high-anxious individuals did not differ in their affective response to future worry ($b = -0.06$, $p = .40$). Participants' thinking style only did not significantly explain variability between effect sizes ($b = -0.26$, $p = .14$). Fig. 2 illustrates the effect of the future worry induction in a forest plot (a funnel plot is available in the online supplement).

3.5. Study characteristics in the PAST-cluster

The 27 studies in the PAST-Cluster included a total of 2119 participants (63.70% female) with a mean age = 27.09 years mostly from student samples ($k = 20$) and seven samples of mixed age. All studies assessed affect outcome immediately following imagination task (no pre-assessment). Twenty studies used one-item-scales (e.g. “The emotions I have when I imagine the event are (−3 = very negative, +3 = very positive), four studies used a composite of two emotion items and three studies assessed affect via rating scales of multiple emotions (e.g. ‘anxious’, ‘excited’, ‘happy’, ‘distressed’, etc.). Imagined future and remembered past events were of predetermined positive ($k = 14$), negative ($k = 9$) or not predetermined valence, and 12 studies chose the exact same event imagined in the future and remembered in the past. Additionally, five studies also included counterfactual events. Most studies applied within-subject designs ($k = 14$). Therefore, effect sizes were calculated by comparing affective outcome in the future condition with those in the past condition.

Detailed study characteristics are shown in Table 1.

3.6. The impact of future imagination versus past remembrance on affect (PAST-cluster)

The affective response after imagining a future event compared to remembering a past event of same valence for 27 studies differed significantly, $g = 0.45$, 95% CI [0.19, 0.72], $p < .001$. Heterogeneity between effect sizes was large ($\tau = 0.54$). This moderate effect indicates a stronger (negative or positive) affective response to imagining future events compared to remembering past events. Within-study moderators were too diverse to allow moderation analyses, but variations in applied imagination tasks were captured in between-study moderators and tested. Valence of events accounted for variability between effect sizes, where the strongest future-past difference occurred when event valence was not predetermined ($g = 0.61$, $p < .001$) compared to when it was predetermined to be negative ($g = 0.37$, $p = .02$); a non-significant difference was found when events were predetermined to be positive ($g = 0.18$, $p = .27$). Future-past differences were also more pronounced when imagination was applied via writing compared to only imagination ($b = 0.58$, $p = .04$, same tendency arose when sole imagination was compared to combined imagination and writing). When future imagination was compared to counterfactual past imagination, differences in affect only reached marginal significance, pointing to a tendency of stronger affective response in future simulation, $g = 0.46$, $p = .09$ (with large heterogeneity; $\tau = 0.63$). Details of these results are shown in Table 2. Further, temporal distance of events (in month) and event equality (exact same vs. different event in past and future) were tested as moderators but did not account for variability, $p = .10$ and $p = .71$, respectively. Fig. 2 illustrates the effect of future imagination compared to past remembrance in a forest plot (a forest plot for counterfactual imagination is available in the online supplement).

3.7. Quality assessment & publication bias

The quality of studies varied between single studies and study clusters; for a detailed evaluation of each study, see Table 1. Studies in the BEST-Cluster were of highest methodical quality, as they applied mostly validated affect scales and randomization procedures, but attrition rates were not always reported and rarely considered statistically. Studies in the WOR-Cluster provided the most detailed report of task instructions and sample characteristics, but they rarely included

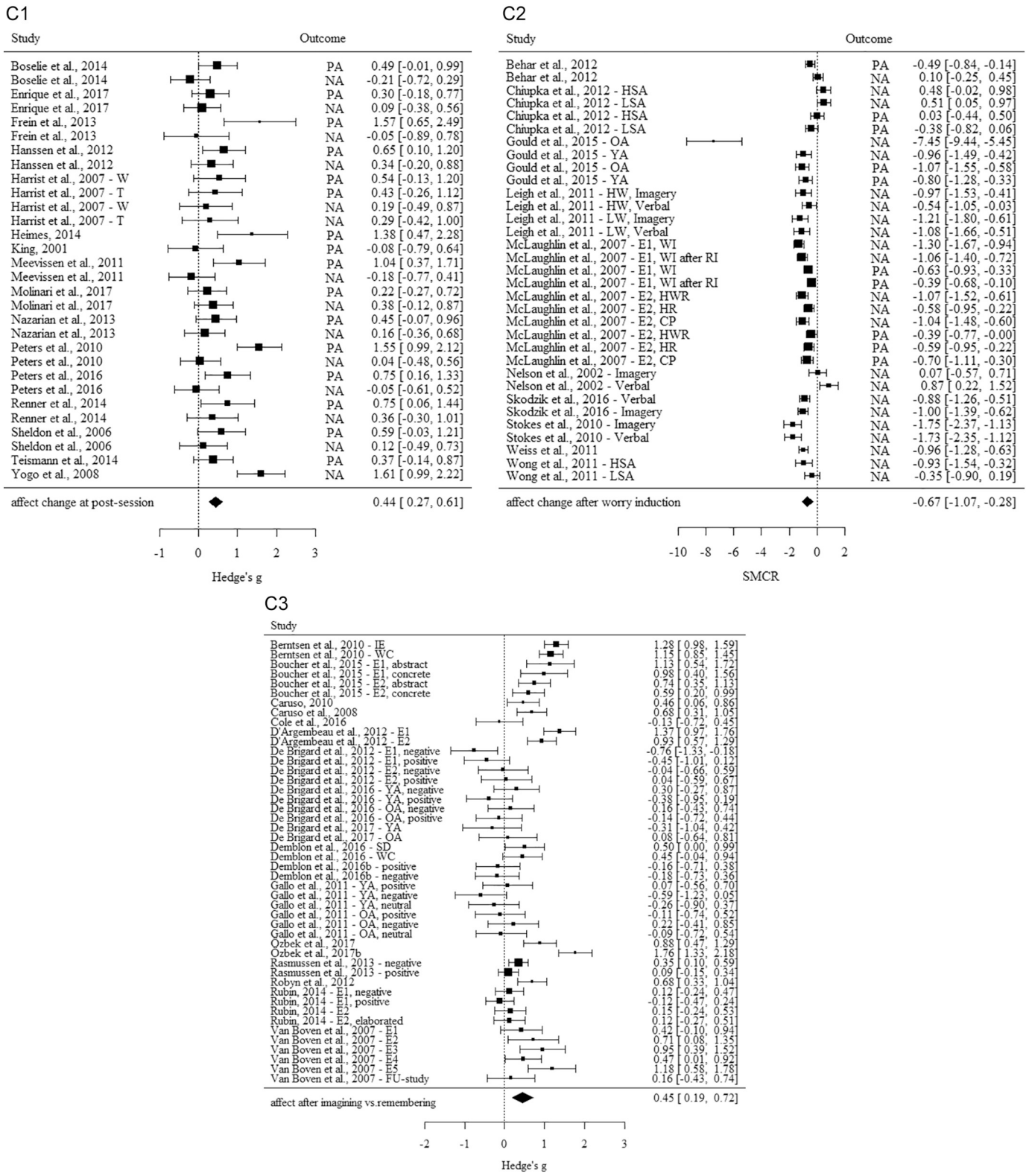

Fig. 2. Forest plots of Hedges' *g* or *SMCR* with 95% confidence intervals, separately for each cluster A) in the *best possible self imagination* cluster (BEST-Cluster) change in affect compared to control groups (after one session) is shown; B) in the *future worry* cluster (WOR-Cluster) pre-post-change after one session is shown; in the *past comparison* cluster (PAST-Cluster) differences in affect when imagination the future versus remembering the past are shown; Thickness of boxes represents weight of each outcome. Valence of the imagined event (positive, negative or neutral) or thinking style (imagery, verbal, concrete, abstract) is specified when important to distinguish groups within a study. CP = control participants; D = depression; E1–5 = experiment 1–5; FU-study = follow-up study; HAS = high socially anxious; HW = high worriers; HR = high ruminating individuals; HWR = high worrying and ruminating individuals; IE = important event; LSA = low socially anxious; LW = low worriers; NA = negative affect; NPT = no peer testimonial; OA = older adults; PA = positive affect; PT = peer testimonial; RI = rumination induction; SMCR = standardized mean change with raw score standardization; S = satisfaction; SD = self-defining; UE = unlikely event; WC = word-cued; WI = worry induction; YA = younger adults.

Table 1
Study characteristics of studies in quantitative synthesis separate for each study cluster.

Publication	Number of participants in analyses	Type of intervention	Dosage	Type of control group	Populations	Mean Age (SD)	Female %	Outcome	Assessment-points	Q1	Q2	Q3	Q4	Q5
BEST-cluster														
*Boehm, Lyubomirsky, & Sheldon (2011)	220	BPS (based on *King, 2001)	10 min × 6 weeks (once a week)	List of past week experiences	General	35.62 (11.36)	53	SWLS	Pre-, post-intervention, 4-weeks FU	+ +	+	+ −	+	+ −
*Boselie et al. (2014)	74	BPS (based on *King, 2001)	21 min × 1	Typical day imagination	Undergraduate students	21.90 (2.29)	78	PANAS-S (state)	Pre-, post-session	+ +	+	+	+	+
*Enrique, Bretón-López, Molinari, Baños, & Botella (2018)	78	BPS (technology-based, reminders twice a week)	25 min initial; 5 min × 4 weeks (once a day)	Daily activities imagination	Students and employees	23.80 (3.85)	65	PANAS (trait) BDI-II	Pre- Post-session, Post-intervention, 12-weeks FU	+/+	+ +	+	+	+ −
*Frein & Ponsler (2014) Experiment 1	39	BPS (based on *King, 2001)	15 min initial; 15 min × 4 days (once a day)	Daily activities imagination	Undergraduate students	20.60 (n.a.)	8	PANAS (state)	Pre-, post-session, Pre-, post-intervention	+	+	−	+ −	−
*Hanssen et al., (2013)	79	BPS (based on *King, 2001)	21 min × 1	Typical day imagination	Students	22.59 (2.86)	81	VAS: PA	Pre-, post-session	+	+	+	+	+ −
*Harrist et al. (2007)	75	BPS (based on *King, 2001; writing vs. talking)	20 min × 4 days (once a day)	Essay on a neutral topic	Students	21 (range = 18–45)	67	Mood Rating Scale (PA only)	Pre-, post-sessions	+ +	+	−	+ −	+
*Heimes (2013)	28	BPS (based on *King, 2001)	20 min × 3 days (once a day)	Essay on a neutral topic	Students	40.32 (n.a.)	96	PANAS-S (state)	Pre-, post-session, Pre-, post-intervention 8-weeks FU	+ +	+ −	+ −	+	+
*King (2001)	81	BPS (based on *King, 2001)	20 min × 4 days (once a day)	Essay on today's plans	Students	21.04 (3.15)	85	Mood Rating Scale (PA only) SWLS	Pre-, post-session, 3-weeks FU	n.a.	+	−	+	+
*Layous, Nelson, & Lyubomirsky, 2013	131	BPS (different domain each session; with vs. without peer testimonial on efficacy of intervention; online vs. laboratory)	15 min × 4 weeks (once a week)	List of today's experiences	Undergraduate students	19.10 (1.77)	72	Affect-Adjective Scale (PA only)	Pre-, post-intervention	+ +	+	+ −	+	+
*Lyubomirsky et al. (2011)	330	BPS (based on *King, 2001; adapted for multiple domains)	15 min × 8 weeks (once a week)	Past week experiences	Undergraduate students	19.66 (2.91)	71	Composite: PA (3 items), NA (3 items), SWLS and SHS	Pre-, post-intervention, 6-months-FU	n.a.	+	+ −	+	+
*Manthey, Vehreschild, & Renner (2016)	435	BPS (based on *King, 2001, *Sheldon & Lyubomirsky, 2006 and *Lyubomirsky et al., 2011)	20 min × 8 weeks (overall 6 times)	To-do-list	Students and employees	33.70 (9.60)	84	SWLS SPANE	Pre-, post-intervention, 4-weeks FU	+ +/+ +	+ +	+ −	+	+
*Meevissen et al. (2011)	54	BPS (based on *King, 2001; after imagery training)	20 min initial; 5 min × 2 weeks (once a day)	Daily activities imagination	Students	23.50 (6.39)	93	PANAS (state, week)	Pre-, post-session, Pre-, post-intervention	+ +	+	+ −	+	+
*Molinari, García-Palacios, Enrique, Roca, Fernández-Llanio, & Botella, (2018)	71	BPS (based on *King, 2001; technology-supported)	25 min initial;5 min × 1 month (3 times a week)	Daily activities imagination	Fibromyalgia patients	51.08 (10.54)	100	PANAS (trait)	Pre-, post-session, Pre-, post-intervention, 12-weeks FU	+	+ +	+	+	+ −

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Table 1 (*continued*)

Publication	Number of participants in analyses	Type of intervention	Dosage	Type of control group	Populations	Mean Age (SD)	Female %	Outcome	Assessment-points	Q1	Q2	Q3	Q4	Q5
*Nazarian & Smyth (2013)	204	BPS (based on *King, 2001 and (Austenfeld, Paolo, & Stanton, 2006)	20 min × 3 weeks (once a week)	Essay on non-emotional future plans	Undergraduate students vs. community sample	19 (range = 18–23) vs. 41 (range = 18–74)	57 vs. 79	PANAS-I (state)	Pre-, post-session	+	+ +	+ −	+	+ −
*Ng (2016) Study 2	216	BPS (based on *Sheldon & Lyubomirsky, 2006)	3 weeks	Description of a place	General	28 (range = 20–61)	63	6 items each: PA and NA (3 weeks) SHS	Pre-, post-intervention	+ +	+	−	+ −	+ −
*Peters, Flink, Boersma, & Linton (2010)	82	BPS (based on *Sheldon & Lyubomirsky, 2006)	21 min × 1	Typical day imagination	Students	29.60 (range = 21–50)	62	PANAS (state)	Pre-, post-session	+ +	+	−	+ −	+
*Peters, Meevissen, & Hanssen (2013)	82	BPS (after imagery-training; imagining different domain each day)	20 min initial; 5 min × 1 week (once a day)	Typical day imagination	General	22.80 (range = 18–65)	84	SWLS	Pre-, post-intervention, 1-week-FU	+	+	−	+	+ −
*Peters et al. (2016)	56	BPS (based on *King, 2001)	21 min × 1	Typical day imagination	Students	23.50 (3.30)	57	PANAS-S (state)	Pre-, post-session	+	+	−	+	+
*Renner, Schwarz, Peters, & Huibers (2014)	40	BPS (based on *Sheldon & Lyubomirsky, 2006; after negative mood induction)	21 min × 1	Typical day imagination	Undergraduate students	22.10 (range = 19–38)	80	PANAS (state)	Pre-, post-session	+ +	+	−	+	+ −
*Seear & Vella-Brodrick (2013)	211	BPS (based on *Sheldon & Lyubomirsky, 2006)	1 week (once a day)	No activity	Students and employees	34.00 (13.97)	75	WEMWBS PANAS (week)	Pre-, post-intervention, 2-weeks-FU	+ +/+ +	+	+ −	+	+ −
*Shapira & Mongrain (2010)	1002	BPS (current issues resolved, sage advice from future self)	1 week (once a day)	Essay on a past experience	General	34 (range = 18–72)	82	SHI	Pre-, post-intervention, 6-months-FU	+ +	+ +	+	+ −	+ −
*Sheldon & Lyubomirsky (2006)	67	BPS (adapted from *King, 2001)	Initial session; n.a.	Typical day imagination	Undergraduate students	n.a. (n.a.)	75	PANAS (trait)	Pre-, post-session, 4-weeks-FU	+ +	+	+ −	+ −	+ −
*Teismann, Het, Grillenberger, Willutzki, & Wolf (2014)	64	BPS (write about life goals)	20 min × 3 days (once a day)	Essay on a neutral topic	Students and general	29.10 (8.42)	63	CMS	Pre-, post-session, Pre-, post-intervention	+ +	+ +	+ −	+	+
*Troop, Chilcot, Hutchings, & Varnaite (2013)	46	BPS (based on *King, 2001)	45 min × 1	Essay on a neutral topic (film, book, non-emotional)	Students	25.80 (9.30)	67	TPAS	Pre-session, 2-weeks-FU	+ +	+	−	+	+ −
*Yogo & Fujihara (2008)	104	BPS (based on *King, 2001)	20 min × 3 weeks (once a week)	Trivial writing task	Undergraduate students	n.a. (range = 18–19)	71	10 items each: Depression and anxiety	Pre-, post-session, Pre-, post-intervention	+	+	+ −	+ −	+ −
WOR-cluster														
*Behar et al. (2012)	108	Repetitively thinking of holding a speech	22.5 min × 1	n.a.	Undergraduate students	18.92 (1.34)	51	PANAS (state)	Pre-, post-session	+ +	+	−	+	+
*Chiupka, Moscovitch, & Bielak (2012)	42	Anticipation (images, feelings, sensations) of holding a speech	1 min × 1	n.a.	High vs. low socially anxious students	19.71 (3.29)	75	PANAS-S (state)	Pre-, post-session	+ +	n.a.	+	+	+
*Gould et al. (2015)	108	Worry about 3 self-selected topics in usual fashion	5 min × 1	Positive PastCC	Young vs. elderly	21.40 (2.60) vs. 69.10 (8.10)	59	MAACL-R	Pre-, post-session	+ +	+	+ +	+	+

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Table 1 (*continued*)

Publication	Number of participants in analyses	Type of intervention	Dosage	Type of control group	Populations	Mean Age (SD)	Female %	Outcome	Assessment-points	Q1	Q2	Q3	Q4	Q5
*Leigh & Hirsch (2011)	48	Verbal vs. imagery worry focusing task (after mentation training)	5 min × 1	n.a.	High vs. low worriers	25.57 (10.37) vs. 27.69 (10.90)	83 vs. 58	VAS: Anxiety	Pre-, post-session	−	+ −	+	+	+
*McLaughlin, Borkovec, & Sibrava (2007) Study 1	60	Worry about most worrisome topic (of 3 topics) before vs. after rumination-induction	5 min × 1	n.a.	Undergraduate students	n.a. (n.a.)	73	PANAS (state)	Pre-, post-session	+ +	+ −	+	+ −	+
*McLaughlin et al. (2007) Study 2	109	Worry about most worrisome topic (of 3 topics) before vs. after rumination-induction	5 min × 1	n.a.	Worrying/ ruminating undergraduates vs. control undergraduates	18.60 (n.a.)	75	PANAS (state)	Pre-, post-session	+ +	+ −	+	+ −	+
*Nelson & Harvey (2002)	31	Imagery vs. verbal imagination about holding a speech (after training)	6 min × 1	n.a.	Students with insomnia	n.a. (n.a.)	55	1 item: Anxiety	Pre-, post-session	−	−	+	+	+
*Skodzik, Zettler, Topper, Blechert, & Ehring (2016)	125	Imagery vs. verbal worry about holding a speech (after mentation training)	7 min × 1	Distraction task	Students	22.91 (2.96)	74	PANAS-S (NA only, state)	Pre-, post-session	+ +	+	+	+	+
*Stokes & Hirsch (2010)	60	Imagery vs. verbal worry (after mentation training)	5 min × 1	n.a.	High worriers (students)	26.09 (11.07)	88	VAS: Anxiety, depression and happiness	Pre-, post-session	+ −	+	+	+	+
*Weiss & Hope (2011)	54	Worry-induction (adapted from Molina et al., 1998)	5 min × 1	n.a.	Homosexuals	32.85 (14.48)	50	STAI-S (NA only)	Pre-, post-session	+ +	−	−	+	+
*Wong & Moulds (2011)	80	Think about holding a speech, guided by 45 items	7 min × 1	Distraction task	High vs. low socially anxious students	21.49 (7.17)	61	VAS: Anxiety	Pre-, post-session	−	+	−	+	+ −
PAST-cluster														
*Berntsen & Bohn (2010)	122	Describe 5 future events that were cued by words vs. "important in your life"	22.5 min × 1	PastCC	Students	26.53 (range = 21–47)	84	1 item: Valence of emotion	Post-session	−	+ −	−	+ −	+ −
*Boucher & Scoboria (2015) Study 1	119	Describe future transitional event in abstract vs. concrete way	7 min × 1	PastCC	Undergraduate students	22.61 (5.22)	83	Composite: Valence of emotion and strength of positive and negative emotion (one item each)	Post-session	+ −	+	+	+	+
*Boucher & Scoboria (2015) Study 2	251	Describe future transitional event in abstract vs. concrete way	7 min × 1	PastCC	General	33.41 (11.43)	47	Composite: Valence of emotion and strength of positive and negative emotion (one item each)	Post-session	+ −	+ −	+	+	+

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Table 1 (*continued*)

Publication	Number of participants in analyses	Type of intervention	Dosage	Type of control group	Populations	Mean Age (SD)	Female %	Outcome	Assessment-points	Q1	Q2	Q3	Q4	Q5
*Caruso (2010) Experiment 5	121	Imagine playing Ultimatum Game and being treated unfairly	1	Negative PastCC	General	n.a. (n.a.)	n.a.	1 item: NA	Post-session	+	−	−	−	+ −
*Caruso et al. (2008) Experiment 3	148	Imagine helping a neighbor move out of his apartment one week in the future	1	Negative PastCC	Students	n.a. (n.a.)	n.a.	1 item: NA	Post-session	+ +	−	−	−	+ −
*Cole & Berntsen (2016)	55	Imagine future events in reaction to 12 cue phrases	1 min × 1	PastCC	General	24.31 (6.56)	78	1 item: Mood	Post-session	−	+	+	+	+ −
*D'Argembeau, Lardi, & Van der Linden (2012) Study 1	72	Write down 3 self-defining future projections with much detail	1	PastCC	Students	21.00 (2.60)	56	1 item: Valence of emotion	Post-session	−	+ −	−	+ −	+ −
*D'Argembeau, Lardi, & Van der Linden (2012) Study 2	78	Write down 3 self-defining future projections with much detail	1	PastCC	General	32.00 (9.10)	60	1 item: Valence of emotion	Post-session	−	+ −	+ −	+ −	+ −
*De Brigard & Giovanello (2012) Experiment 1	30	Choose two positive and two negative past events, generate future events of same topic	1	Negative PastCC Positive PastCC Negative CCC Positive CCC	Undergraduate students	20.40 (5.40)	60	1 item: Valence of emotion	Post-session	−	+ −	−	+	+ −
*De Brigard & Giovanello (2012) Experiment 2	24	Choose six autobiographical events and one week later generate future events of same topic	3 min × 1	Negative PastCC Positive PastCC Negative CCC Positive CCC	Undergraduate students	23.54 (8.87)	54	Composite: Valence of emotion when recalling and during event (one item each)	Post-session	−	+ −	−	+	+
*De Brigard, Rodriguez, & Montañés (2017)	36	Memories turned into future events, describe them out loud	3 min × 1	PastCC CCC	Young vs. elderly	19.10 (1.80) vs. 67.00 (3.95)	61 vs. 39	1 item: Valence of emotion	Post-session	−	+ −	+	+	+
*De Brigard, Giovanello, Stewart, Lockrow, O'Brien, & Spreng (2016)	60	Imagine and describe out loud with much detail 4 future events	1,75 min × 1	Negative PastCC Negative CCC Positive PastCC Positive CCC	Young vs. elderly	22.35 (3.27) vs. 69.32 (4.85)	63 vs. 60	Composite: Valence of emotion when recalling and during event (one item each)	Post-session	−	+ −	−	+	+
*Demblon & D'Argembeau (2017)	40	Imagine future-event (self-defining vs. spontaneously coming to mind) and think of related events in the future	1	PastCC	Students	21.50 (2.12)	50	1 item: Valence of emotion	Post-session	−	+ −	−	+	+ −
*Demblon & D'Argembeau (2016)	32	Imagine future-event (positive vs. negative) and think of related events in the future	1	Positive PastCC Negative PastCC	Students	25.00 (2.40)	50	1 item: Valence of emotion	Post-session	−	+ −	+	+ −	+ −
*Gallo, Korthauer, McDonough, Teshale, & Johnson (2011)	48	Imagine future events related to cue words (neutral vs. positive vs. negative)	1	Positive PastCC Negative PastCC	Undergraduate students vs. elderly	20.00 (1.60) vs. 75.00 (6.90)	88 vs. 79	1 item: Valence of emotion	Post-session	−	+ −	−	+ −	+

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Table 1 (*continued*)

Publication	Number of participants in analyses	Type of intervention	Dosage	Type of control group	Populations	Mean Age (SD)	Female %	Outcome	Assessment-points	Q1	Q2	Q3	Q4	Q5
				Neutral PastCC										
*Lardi Robyn, Ghisletta, & Van der Linden (2012)	79	Write down 3 self-defining future projections with much detail	1	PastCC	Undergraduate students and general	23.29 (2.44)	51	1 item: Valence of emotion	Post-session	−	+ −	−	+	+ −
*Özbek, Bohn, & Berntsen (2017)	60	Write down most-important future event	1	PastCC CCC	Undergraduate students	21.10 (1.51)	80	1 item: Valence of emotion	Post-session	−	+ −	−	+	+ −
*Özbek, Bohn, & Berntsen (2018)	69	Write down 3 important future events	1	PastCC CCC	Undergraduate students	21.09 (2.20)	58	1 item: Valence of emotion	Post-session	−	+ −	−	+	+ −
*Rasmussen & Berntsen (2013)	158	Write brief description of future event (positive vs. negative)	1	Negative PastCC Positive PastCC	Undergraduate students	24.44 (4.13)	84	1 item: Valence of emotion	Post-session	−	+ −	−	+	+ −
*Rubin (2014) Experiment 1	76	Imagine 3 positive and 3 negative future events that impact one a lot	1	Negative PastCC Positive PastCC	Undergraduate students	19.02 (1.06)	61	1 item: Valence of emotion	Post-session	−	−	−	+	+ −
*Rubin (2014) Experiment 2	63	Imagine 3 negative future events, then same events more elaborated	1	Negative PastCC	Undergraduate students	19.02 (0.98)	60	1 item: Valence of emotion	Post-session	−	−	−	+	+ −
*Van Boven & Ashworth (2007) Study 1	36	Contemplate about upcoming Thanksgiving in 2 weeks	1	Positive PastCC	Students	n.a.	58	1 item: Happiness	Post-session	−	+ −	−	+ −	+ −
*Van Boven & Ashworth (2007) Study 2	51	Think of next menstruation vividly	1	Negative PastCC	Students	n.a.	100	1 item: NA	Post-session	−	+	+	+ −	+ −
*Van Boven & Ashworth (2007) Study 3	61	Listen to 5-s aversive sound and contemplate listening to a 58-s version of it	1	Negative PastCC	Students	n.a.	56	List of 15 adjectives (NA)	Post-session	+ +	+	−	+ −	+ −
*Van Boven & Ashworth (2007) Study 4	95	Imagine a future all-expenses-paid ski vacation in a 5-star hotel	1 min × 1	Positive PastCC	Students	n.a.	n.a.	1 item: Happiness	Post-session	−	+	−	−	+
*Van Boven & Ashworth (2007) Study 5	83	Listen to 5-s aversive sound and contemplate listening to a 58-s version of it	30 s × 1	Negative PastCC	Students	n.a.	n.a.	List of 15 adjectives (NA)	Post-session	+ +	+	−	−	+
*Van Boven & Ashworth (2007) FU-Study	52	Listen to 5-s aversive sound and contemplate listening to a 58-s version of it	1	Negative PastCC	Students	n.a.	40	List of 10 adjectives (NA)	Post-session	+ +	+	−	+ −	+ −

Note. Studies are shown separately for study clusters, i.e. the *best possible self imagination* cluster (BEST-Cluster), the *future worry* cluster (WOR-Cluster) and the *past comparison* cluster (PAST-Cluster). BDI-II = Beck's Depression Inventory – II; BPS = Best Possible Self; CCC = Counterfactual Control Condition; CES-D = Center for Epidemiological Studies Depression Scale; CMS = Current Mood Scale; FU = Follow-Up; MAACL-R = Multiple Affect Adjective Checklist-Revised; NA = Negative Affect; n.a. = not reported (n.a. in Quality assessment = not ratable); PA = Positive Affect; PANAS = Positive and Negative Affect Schedule; PANAS-I = Positive and Negative Affect Schedule – Immediate version; PANAS-S = Positive and Negative Affect Schedule – Short form; PANAS-X = Positive and Negative Affect Schedule – Expanded form; PastCC = Past Control Condition; PWB = Psychological Well-Being Scale; Q1 = affect scaling; Q2 = randomization; Q3 = attrition/exclusion; Q4 = sample report; Q5 = intervention report; SHI = Subjective Happiness Scale; SHS = Subjective Happiness Scale; SPANE = Scale of Positive and Negative Experience; STAI-S = State-Trait Anxiety Inventory – State form; SWLS = Satisfaction with Life Scale; TPAS = Types of Positive Affect Scale; VAS = Visual Analogue Scale; WEMWBS = Warwick-Edinburgh Mental Wellbeing Scale; − = 0; + − = 1; + = 2; + + (only Q3-Q5) = 3. When the study used more than one scale, Q1 also has more than one rating.

randomized control groups and validated affect scales. The lowest relative quality was found for the PAST-Cluster, since these studies aimed to cover a variety of perceptual measures in multiple future and past events and therefore condensed measurement of affect to one-item scales in counterbalanced within-subjects instead of randomized between-subjects designs. To assess whether study quality was related to the present findings, we rerun meta-analyses by insertion of quality assessment items as moderator variables. Results revealed that study quality did not to influence the results.

To address possible publication bias, funnel plots of all three study clusters were visually inspected. For the BEST-Cluster, a symmetric funnel plot was observed, indicating a low likelihood of publication bias. For the WOR-Cluster and the PAST-Cluster, funnel plots were shaped slightly asymmetric, suggesting the possibility of missing studies on the right side of the funnel. Funnel plots are available in the online supplement.

3.8. Narrative review of remaining studies

Since the remaining studies were found to be too heterogeneous to compile into a separate cluster, they are reviewed narratively below. Three publications by the same author were initially considered for eligibility but were not included due to multiple retracted publications in the context of invalid data and research errors (for additional information see online supplement).

In two experiments, students reported stronger affect when (positive or negative) imagined scenarios were (manipulated and believed to be) more likely to happen (*Gregory, Cialdini, & Carpenter, 1982). *Greitemeyer and Würz (2006) only found a stronger affective response to imagination (vs. no imagination) in difficult (not easy) health goals and positive (not negative) affect (equally for process and outcome imagination). For two mastery imagination scenarios, *Schultheiss and Brunstein (1999) found stronger affect compared to no or neutral imagination which was mediated by participants' power and affiliation motives. In two experiments manipulating temporal distance, short distance future imagination (on the order of days) elicited higher anxiety and lower optimism ratings while the reverse was true for long-distance future imagination (on the order of years; *Castaño, Sujan, Kacker, & Sujan, 2008; but no effect found in less elaborated imagination by *Demeyer & Raedt, 2014). *Vella and Moulds (2014) transferred insights regarding vantage perspective onto positive future event imagination, and they found that the more vivid personal field perspective elicited higher ratings of happiness than the same scenarios from a less vivid observer perspective (see also *Margolies and Crawford, 2008 who found the same pattern for ego-moving vs. time-moving perspective). When applying future imagination on a daily basis over one week, positive scenarios only increased happiness while neutral scenarios only reduced anxiety and negative scenarios did not influence any affect quality (*Quoidbach, Wood, & Hansenne, 2009). In a similar two-week experiment, *Fishbach and Hofmann (2015) found that imagining both obstacles and their resolution led to the highest happiness ratings compared to imagining only obstacles and to the no imagination condition.

4. Discussion

In the present meta-analysis, we found certain forms of future imagination to have a moderate to strong impact on individuals affect in various ways. Studies from different fields demonstrated that future imagination can promote positive affect (PA) when participants anticipate a bright future life and it can increase negative affect (NA, mainly anxiety) when participants worry about negative future scenarios. A stronger magnitude on affect was found for imagining the future when comparing to remembering the past.

Comparisons of results from best possible self imagination task against mainly active control groups (96% of the included studies) provide strong evidence of this task's effectiveness and indicate that it outperforms existing positive psychology interventions that share the goal of promoting affective well-being (Sin & Lyubomirsky, 2009). However, as long-term affective change was only reported in highly motivated subsamples (*Lyubomirsky et al., 2011), and the few studies on patients with depression reported rather low to mixed benefit (Huffman et al., 2014; *Molinari et al., 2018), it remains unclear to what extent these interventions can effectively boost affective well-being in clinical application. Future research needs to investigate whether more frequent exposure to best possible self imagination task can have long-lasting impact on affective well-being.

With respect to future worry, the included studies in this review were restricted to those studies applying clear-cut future-directed instructions (i.e., not open to past rumination or present repetitive thinking). This line of research suggests a high impact of future worry on negative affect in general (7 studies) and state anxiety in particular (4 studies). Applying this precision, the present results support the findings that prior conceptualizations of future worry are most anxiety-provoking when the topics are long-term “individual catastrophes” (Borkovec & Inz, 1990) rather than short-term social performance tasks (that are often equated, see *Behar et al., 2012). Comparing verbal to imagery-based thinking style in future worry only resulted in a marginal significant difference, but given the relatively low number of studies in this category ($n = 4$), results should be interpreted cautiously (Borkovec et al., 2004; Hirsch & Mathews, 2012; Stöber & Borkovec, 2002). Interestingly, engaging in future worry was equally distorting for low- and high-anxious individuals, which may highlight the fundamental role that worry plays as a maladaptive cognitive strategy (Borkovec et al., 1993; Wells, 1995).

Ultimately, the direct comparison of future imagination to past remembrance hints one's future outlook plays a significant role in people's lives (*Caruso et al., 2008; *D'Argembeau, Lardi, & van der Linden, 2012; *Rasmussen & Berntsen, 2013), in particular when studying younger populations (Frazier, Barreto, & Newman, 2012). While past events are left unchangeable in time, for constructing a potential future, people use their most remarkable memories, driven by their major motives, meaningful themes and dominant schemata (*Demblon & D'Argembeau, 2017; *Rubin, 2014). Additionally, when people believe that they will master future challenges (or that they will fail miserably), this might more strongly impact their present self-concept than past successes or defeats, which can be simply attributed to a “past self” that no longer exists. This different affective impact of past and future events might also vary along with people's age, their respective future expectations and gained life experience. However, this could not be directly tested due to the limited number of studies directly comparing different age groups. Unsurprisingly, a more similar affective response emerged from comparing future imagination to counterfactual imagination, which enables people to mentally change past events according to their desires (Schacter, Benoit, De Brigard, & Szpunar, 2015) as this technique is clinically applied in imagery rescripting trauma therapy (Morina, Lancee, & Arntz, 2017). Whether the exact same or different events were imagined in the past and future did not affect the results, possibly indicating that it is not the content itself but rather the particular ascribed meaning of an event that influences our affective response (*Demblon & D'Argembeau, 2016; Rathbone, Conway, & Moulin, 2011).

Our investigation had some limitations. The meta-analytic part of the present review was limited to the existing future imagination tasks adopted in primary studies that allowed synthesis. Therefore, it must be stated that both the best possible self imagination and worry induction tasks might be rather examples of the extreme ends of people's affective responses than representing their reaction to average future imaginations in daily life. Since the study aims, the applied experimental designs and the obtained effect sizes all vary across clusters, we could not directly compare the differential magnitudes of positive, negative or future vs. past imagination on affect. Various affect scales using

Table 2
Effect sizes and results of moderator analyses for all study clusters.

BEST-Cluster		*k*	*o*	*g*	*SE*	95%CI	*p*
Baseline-post session		16	20	0.44	0.09	[0.27, 0.61]	< .001
Moderated by: outcome measure	NA	14	NA	0.21	0.11	[-0.01, 0.44]	.06
	PA	16	PA	0.64	0.11	[0.43, 0.85]	< .001
Baseline-post intervention		15	30	0.34	0.09	[0.16, 0.52]	< .001
Moderated by: outcome measure	NA	8	NA	0.33	0.13	[0.08, 0.57]	.02
	PA	12	PA	0.44	0.11	[0.22, 0.66]	< .001
	S	7	S	0.23	0.11	[0.01, 0,45]	.04
	D	3	D	0.35	0.15	[0.05, 0.65]	.02
Baseline-follow-up		11	22	0.12	0.08	[-0.04, 0.28]	.08

WOR-Cluster		*k*	*o*	*SMCR*	*SE*	95%CI	*p*
Pre-post-change (one session)		11	33	-0.67	0.20	[-1.07, -0.28]	< .001
Moderated by:							
Anxiousness	High	5	8	-0.73	0.32	[-1.36, -0.11]	.02
	Low	4	5	-0.80	0.36	[-1.49, -0.10]	.03
Thinking style	Verbal	4	5	-0.66	0.46	[-1.56, -0.24]	.15
	Imagery-based	4	5	-0.93	0.46	[-1.83, -0.02]	.04
Worry content	Subsequent speech	5	12	-0.23	0.21	[-0.64, 0.19]	.28
	Meaningful topic	6	21	-1.09	0.21	[-1.50, -0.69]	< .001

PAST-Cluster		*k*	*o*	*g*	*SE*	95%CI	*p*
Future vs. past events		27	46	0.45	0.13	[0.19, 0.72]	< .001
Moderated by:							
Event valence	Negative	9	17	0.37	0.15	[0.07, 0.67]	.02
	not predetermined	12	18	0.61	0.15	[0.32, 0.90]	< .001
	Positive	14	11	0.18	0.16	[-0.14, 0.49]	.27
Application form	Imagination	12	15	0.08	0.22	[-0.35, 0.51]	.70
	Writing	10	19	0.67	0.19	[0.30, 1.04]	< .001
	Imagination & writing	2	4	0.80	0.55	[-0.29, 1.88]	.15
	Imagination & talking	3	8	0.34	0.28	[-0.20, 0.88]	.22
Future vs. counterfactual events		5	16	0.46	0.28	[-0.08, 1.00]	.09

Note. Studies in the *best possible self imagination* cluster (BEST-Cluster) reported change in affect compared to control groups (separately after one session, multiple-session-interventions and follow-up); studies in the *future worry* cluster (WOR-Cluster) reported pre-post-change after one session; studies in the *past comparison* cluster (PAST-Cluster) reported differences in affect when imagination the future versus remembering the past (or counterfactual past); *k* = number of studies; *o* = number of outcomes; *g* = Hedges' *g*; *SMCR* = standardized mean change using raw score standardization; *SE* = standard errors; CI = confidence intervals; *p* = *p*-value; NA = negative affect; PA = positive affect; S = satisfaction; D = depression; underlined moderator categories indicate the reference categories; positive effect sizes indicate affect improvement (BEST-Cluster; WOR-Cluster) or stronger affective response (PAST-Cluster).

different time frames or measuring related but distinct constructs such as affective well-being, depression, anxiety or mood further complicated the interpretation of results. For example, anxiety is typically the most prominent reaction to worry, but represents only one facet of negative affect (beside sadness, guilt and hostility; Ready et al., 2011). Hence, all conclusions – particularly regarding clinical implications – must be drawn with caution. Additionally, the study quality varied between and among each cluster. We addressed the quality issue by testing each quality assessment item in separate moderator analyses without explaining heterogeneity. Still, existing differences in quality may be due to studies with small sample sizes (mainly WOR-Cluster), suboptimal affect measures (PAST-Cluster) and insufficient reporting. Further, high heterogeneity was found in all effect sizes indicating a high variance in true values and, thus, a need for cautious interpretation. Different study aims also meant that the same potential moderators were rarely tested in more than one study (within-study moderators, Higgins & Green, 2012). Thus, moderator analyses mainly relied on between-study moderators that may be restricted in variance (e.g., for temporal distance) and confounded with other study properties, such that they have to be interpreted cautiously. Further, the benefit of restricting studies to highly internally valid experiments is always accompanied by the potential caveat of limited generalizability to the external world, i.e. the more automatic and less conscious imaginative processes of daily life. Finally, although we used various terms to systematically search for articles in the broad field of future imagination research, we may have missed relevant publications.

Future research may particularly benefit from applying knowledge from related fields. Inducing worry in experimental psychopathology research could be intensified by applying writing tasks that could serve to elaborate both imagery-based and verbal processing and by focusing on individually chosen worry topics instead of predetermined content (see Jing, Madore, & Schacter, 2016 for good example). Further, in basic episodic memory research, important prerequisites for improving research quality and enabling sound conclusions require that researchers make methodical choices regarding affect measure (multiple measures and items separating positive affect, negative affect and mood), randomized between-subject designs and precise future-directed instructions. In doing so, studies would be able to thoroughly examine the role of content, its underlying meaning and differentiation between future, past, counterfactual and hypothetical imagination along with their age boundaries. Additionally, more research is needed in distinguishing between potentially relevant factors involved in imagining the far future from those in the near future (e.g. the next five minutes) that has received less attention (see D'Argembeau et al., 2008; D'Argembeau et al., 2011 for preliminary results). Lastly, for adequate review, replication and enhancement of research knowledge, it is necessary for study authors to comprehensively report applied imagination tasks or interventions (including instructions or reference), study procedures (e.g., how randomization was performed) and sample characteristics (i.e., detailed information regarding age and gender distribution).

Clinical work in particular might benefit from a more

comprehensive examination of personal future imagination. Several mental disorders are characterized by low levels of optimism, negative future expectations as well as lower vividness for positive future events (Abramson, Metalsky, & Alloy, 1989; MacLeod & Salaminiou, 2001; Morina et al., 2011). More research is needed to examine potential mechanisms of the deficit in engaging in positive future imagination and being optimistic about positive personal future events in individuals with mental health problems. For example, it has been reported that individuals with depression have difficulties in using emotionally rich imagery-based processing to experience positive affect, which applies to both past and future imagery (Holmes, Blackwell, Heyes, Renner, & Raes, 2016).The acquired knowledge might than be used clinically to promote stronger deliberate positive imagery of the future or better processing of episodic information (see Hitchcock, Werner-Seidler, Blackwell, & Dalgleish, 2017). Imagery-focused therapeutic interventions might be particularly effective in depression and anxiety disorders (Hirsch, Hayes, & Mathews, 2009; Pearson, Naselaris, Holmes, & Kosslyn, 2015; Weßlau & Steil, 2014). Positive personal future imagination —beyond the best possible self task— can be boosted in a number of ways from imagery work developing an idiosyncratic and positive image to encouraging systematic training to be able to better imagine numerous positive future scenarios (Holmes et al., 2016). Further, the relatively strong affective response of future compared to past imagination requires to investigate whether psychotherapy is more effective if a stronger focus is placed on future scenarios than on past events (see Engelhard, van den Hout, Janssen, & van der Beek, 2010 for preliminary findings). To apply our findings to clinical practice, future research needs to precisely distinguish between different measures of affect, well-being, anxiety and mood as well as to examine their relation to psychopathological symptoms and behaviour. This differentiated view on distinct measures is also needed to detect potential adverse effects that positive imagery may have. For example, imagining a bright future could be used solely to boost a depressed person's temporary positive affect (like drinking alcohol as an emotion regulation strategy to reduce anxious mood) but may not activate functional problem-solving strategies (or even hinder them, see Oettingen & Mayer, 2002). To conclude, our findings suggest that clinical research on future imagination would be fruitful for various applications with respect to both improving current interventions as well as providing novel experimentally driven targets for psychological treatment innovation.

The present meta-analysis reveals that affect can be strongly influenced by certain forms of future imagination in a positive or negative way that exceeds comparable effects of past imagination. Future research needs to further examine potential moderators and mediators of personal future imagination as well as the efficacy of future imagination techniques for clinical applications.

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Contributors

T.S. and N.M. designed the study and wrote the codebook. T.S. & R.E. conducted the search and coded the studies. T.S., R.E. & J.S. conducted the analyses. T.S. wrote the first version of the manuscript and all authors were responsible for interpretation of the analyses, editing, and rewriting of the manuscript.

Declaration of Competing Interest

The authors report no financial relationships with commercial interests.

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Appendix A. Supplementary data

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