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A Dimensional Taxonomy of Perceived Characteristics of Major Life Events

Maïke Luhmann

Ruhr University Bochum

Ina Fassbender

Ruhr University Bochum

Mark Alcock

University of Cologne

Peter Haehner

Ruhr University Bochum

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Contact information of corresponding author

Maike Luhmann, Ruhr University Bochum, Faculty of Psychology, maike.luhmann@rub.de

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Abstract

Major life events (MLEs) are studied in many different areas in psychology such as personality development, clinical psychology, or posttraumatic growth. In all of these areas, a common finding is that MLEs differ in their effects on psychological outcomes. However, a framework that allows a systematic examination of these differences is still absent. This paper presents a systematic literature review and 4 empirical studies (N s between 226 and 449, total $N = 1,477$) in which we developed and evaluated a dimensional taxonomy of nine perceived characteristics of MLEs: valence, impact, predictability, challenge, emotional significance, change in world views, social status changes, external control, and extraordinariness. These event characteristics can be measured reliably with the Event Characteristics Questionnaire (ECQ). Perceived event characteristics predicted individual differences in changes in subjective well-being in both retrospective and longitudinal data after MLEs over and above established predictors of subjective well-being such as personality and demographic characteristics. A comparison between the ECQ and established taxonomies of situation characteristics such as the DIAMONDS (Rauthmann et al., 2014) showed high conceptual and empirical convergence between some ECQ subscales (e.g., valence, challenge) with characteristics of situations, whereas other ECQ subscales (e.g., social status changes, external control) were conceptually and empirically distinct from situation characteristics. In sum, including measures of perceived event characteristics in studies on MLEs may enhance our understanding of why MLEs differ in the direction, strength, and duration of their effects on psychological outcomes.

[Word count abstract: 237]

Keywords: major life events; perceived event characteristics; subjective well-being; personality development; situation characteristics

A Dimensional Taxonomy of Perceived Characteristics of Major Life Events

Major life events (MLEs) are studied in many different fields of psychological research. For example, the impact of MLEs on subjective well-being (SWB) is examined to test set-point theory, which asserts that lasting changes in SWB are rare because people adapt quickly to changes in their life circumstances (Brickman & Campbell, 1971; Lykken & Tellegen, 1996). In clinical research, the frequency of adverse MLEs is used as an indicator of people's overall life stress, which is a reliable predictor of various forms of psychopathology (Keyes, Hatzenbuehler, & Hasin, 2011; Monroe & Reid, 2009). MLEs are central in theories on meaning making (Park, 2010), resilience (Bonanno, Romero, & Klein, 2015), health (Cohen, Murphy, & Prather, 2019), and posttraumatic growth (Jayawickreme & Blackie, 2014; Tedeschi & Calhoun, 2004). In personality research, MLEs are studied to test whether and why personality traits change (Bleidorn, Hopwood, & Lucas, 2018; Roberts & Jackson, 2008).

Across these research fields, a common finding is that the effects of different MLEs on psychological outcomes differ in terms of direction, strength, and duration (Bleidorn et al., 2018; Jayawickreme & Blackie, 2014; Lucas, 2007; Luhmann, Hofmann, Eid, & Lucas, 2012). Thus far, explanations for these differences typically distinguish MLEs based on life domains such as work, social relationships, or health (Bleidorn et al., 2018; Cohen et al., 2019; Luhmann, Hofmann, et al., 2012) or based on valence (Frederick & Loewenstein, 1999; Jeronimus, Ormel, Aleman, Penninx, & Riese, 2013). However, neither life domain nor valence can sufficiently account for the differential effects of MLEs on psychological outcomes. For example, many psychological theories predict that negative MLEs should have stronger effects on psychological outcomes than positive MLEs (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Cacioppo, Gardner, & Berntson, 1999; Kahneman & Tversky, 1979), but this notion cannot be confirmed unequivocally (Luhmann, Hofmann, et al., 2012;

Mangelsdorf, Eid, & Luhmann, 2019). Furthermore, even MLEs of the same life domain or with similar valence differ in their effects on psychological outcomes. For example, both terrorist attacks and mass shootings are men-made, collective, potentially traumatic events, yet studies suggest that character strengths grow after terrorist attacks (Peterson & Seligman, 2003), but not after mass shootings (Schueller, Jayawickreme, Blackie, Forgeard, & Roepke, 2015). Similarly, unemployment and divorce are both “negative” MLEs in the sense that they would be rated as undesirable and stressful by most observers, yet only unemployment has lasting negative effects on SWB (Lucas, 2005; Lucas, Clark, Georgellis, & Diener, 2004). A final complication is that valence is often rated by researchers or other people who have not experienced the event themselves (e.g., Headey & Wearing, 1989; Holmes & Rahe, 1967). These “objective” ratings can at best reflect the average or typical desirability of an event but necessarily neglect individual differences in the perceived valence of an event. Divorce, to revisit this example, might be perceived as life-shattering for one person but as a bittersweet relief for another.

The common limitation of these approaches is that by focusing on few or only one characteristic of MLEs, many other differences among MLEs are ignored. Divorce and unemployment might have different effects on SWB, not only because they belong to different domains (i.e., work events might have stronger effects on life satisfaction than family events) or differ in valence (i.e., unemployment might on average be perceived as more negative than divorce), but also because they differ in terms of controllability (i.e., people might on average have more control over getting divorced than over losing their job), predictability (i.e., divorce might on average be more predictable than job loss, particularly because it is usually preceded by a period of separation), and so on.

In sum, why MLEs differ in their effects on psychological outcomes can only be understood if MLEs are distinguished on multiple distinct dimensions. Over the past years, several dimensional taxonomies of characteristics of situations have been developed and

validated (e.g., Edwards & Templeton, 2005; Parrigon, Woo, Tay, & Wang, 2017; Rauthmann et al., 2014). However, as we elaborate below, these taxonomies cannot readily be applied to MLEs because (a) MLEs are conceptually distinct from situations as they are defined in the situation characteristics literature and (b) existing taxonomies of situation characteristics neglect some characteristics that have traditionally been studied in the MLEs literature. In this paper, we therefore present a novel dimensional taxonomy of perceived characteristics of MLEs that was developed with the following desired features in mind. First, the taxonomy should be applicable to a wide range of different MLEs, regardless of valence, life domain, or severity. Second, the taxonomy should be broad yet parsimonious. This desired feature poses a dilemma because breadth can only be achieved at the expense of parsimony and vice versa. To resolve this dilemma, we adopted the same approach that was successfully used to derive taxonomies of characteristics of persons (e.g., Ashton & Lee, 2007; John, Naumann, & Soto, 2008) and characteristics of situations (e.g., Parrigon et al., 2017; Rauthmann et al., 2014), starting out with an extensive list of characteristics that was then reduced to empirically distinguishable and interpretable factors. Third, the characteristics included in this taxonomy should be measurable with standardized and economical questionnaires to enable empirical examinations in large samples. Fourth, the taxonomy should focus on people's perceptions of event characteristics rather than on objective features of the MLEs because we assumed that perceptions of MLEs would be more predictive of psychological outcomes than objective features. Finally, the taxonomy should be developed and validated with respect to real MLEs rather than hypothetical events or everyday situations.

Definition of Major Life Events

In the clinical and stress literature, life events typically refer to stressful, often negative, experiences and are sometimes termed stressful life events (Cohen et al., 2019; B. P.

Dohrenwend, 2006; B. S. Dohrenwend, 1973). This definition, however, excludes events that are not perceived as stressful but nevertheless may have substantial effects on psychological outcomes. In developmental psychology, the term life event is often synonymous with life transitions and refers to important changes in social roles or life phases. The duration of the transition is open and can last several years (e.g., puberty as the transition into adulthood). Others use the term life event more broadly to refer to any event that occurs in one's life, that is, not only major events such as unemployment or divorce, but also minor events such as daily hassles and uplifts (Kanner, Coyne, Schaefer, & Lazarus, 1981). The present research, in contrast, focuses on *major* life events, which we define as events that are clearly timed, disrupt one's everyday routine, and are perceived as personally significant and memorable by those who experienced them (Filipp, 1990; Luhmann, Orth, Specht, Kandler, & Lucas, 2014).

Although MLEs might be regarded as a unique type of situation, they are distinct from situations as studied in the current literature on situation characteristics. Here, situations are defined as “momentary, dynamic, fluctuating, and fleeting circumstances in people's live streams” (Rauthmann, 2015, p. 177) and the terms “event” or “occasion” are used to describe a discrete point in time (Rauthmann, 2015). Obviously, not every situation is an MLE. But are all MLEs special types of situations? In some cases, an MLE can completely coincide with one specific situation (or event, in the situation literature terminology), particularly if the MLE is of very short duration (e.g., a freak accident that is over within a few seconds). Most MLEs, however, are composed of multiple situations (Sheldon, Boehm, & Lyubomirsky, 2013), and these situations can vary substantially in their situational characteristics. For example, the MLE of childbirth is more than just the moment when the baby is born; it comprises all related situations before and after the birth that make this event personally significant and memorable. Hence, we argue that MLEs and situations are overlapping but distinct concepts (for a similar argument, see Brim & Ryff, 1980).

Measurement of Major Life Events

In most studies, MLEs are measured via self-report questionnaires or interviews in which participants are asked to report whether they had experienced specific events. The most common format in questionnaires are life-events checklists (for a review, see Turner & Wheaton, 1997). The MLEs included in these checklists are typically sampled from various life domains such as work, relationships, and health. Studies employing such checklists are usually less interested in specific events and more interested in obtaining a summary score (e.g., the total number of MLEs that a person checked) as an indicator of an individual's level of life stress (Monroe, 2008). Life-events checklists assess MLEs economically but are limited by so-called intracategorical variability (B. P. Dohrenwend, 2006) which refers to the observation that the MLEs that are objectively identical can result in widely different subjective experiences across individuals. A parallel notion exists in situation research, where it was proposed that people's individual experiences of psychological situations may deviate from how these situations are experienced by most other people (reality principle; Rauthmann, Sherman, & Funder, 2015).

In some settings, semi-structured interviews (e.g., Brown & Harris, 1978; Paykel, 1997) are therefore preferred. Interviews allow the participants to describe their subjective experiences in more detail and thereby permit a more idiosyncratic estimate of the nature and impact of specific MLEs on individuals. However, interviews are also time-intensive and costly and cannot practically be used in large-scale samples. Furthermore, both life-events checklists and interviews rely on retrospective reports of MLEs and may not be perfectly reliable due to memory biases. As an alternative to self-reports, MLEs are sometimes inferred from other data, such as entries in official registries or, in longitudinal studies, repeated reports on marital status or work status. However, these methods again suffer from intracategorical variability as they do not consider individual differences in people's subjective perceptions of these events. In sum, existing methods to measure MLEs typically

focus on whether and when specific MLEs have occurred in a specific time window, but rarely assess how these events were perceived by the individuals.

Typological vs. Dimensional Approaches to Describing Major Life Events

Differences among MLEs can be described using two general approaches: the typological approach and the dimensional approach. In the *typological approach*, MLEs are assigned to distinct types or categories (e.g., traumatic vs. non-traumatic, positive vs. negative). This approach is popular in life-events research (see above), but has a number of conceptual limitations that are well known in related research domains such as personality psychology or situation research. In the early days of personality psychology, typological approaches were popular to describe individual differences (e.g., Jung, 1923). Personality typologies have intuitive appeal, but are rarely used in personality research to date because they oversimplify individual differences. The categories are typically based on a few select personality traits and thereby neglect individual differences on other personality traits. Moreover, by grouping people into a small discrete number of categories, it is implicitly assumed that all individuals belonging to one category are identical or at the very least not dissimilar in any relevant way, neither on the personality traits on which the typology is based nor on any other personality traits. To allow for greater individual diversity, it would be necessary to dramatically increase the number of personality types.

The same limitation applies if one attempts to categorize MLEs into different types. These categories would be based on a few characteristics of the events (e.g., positive vs. negative, personal vs. collective) and thereby oversimplify both similarities and differences among MLEs. Similarities would be oversimplified because all MLEs assigned to the same category would be assumed to be similar, and subtle but psychologically meaningful differences among these events would be ignored. Similarly, differences would be oversimplified because MLEs assigned to different categories would be assumed to differ

primarily on the characteristics that define the categories, and differences and similarities among the MLEs on other characteristics would be ignored. Similar to personality typologies, this limitation could only be resolved by dramatically increasing the number of categories. Studies investigating differences among MLEs would then have to rely on very large samples to ensure that each event category is represented with adequate statistical power, which would be extremely difficult to achieve in practice.

In personality psychology, the limitations of typological approaches were recognized decades ago and fueled the development of *dimensional approaches* where individual differences were described on multiple continuous dimensions. The total number of dimensions was typically reduced through factor analysis. The Five-Factor Model (John et al., 2008) and the HEXACO model (Ashton & Lee, 2007) are based on such approaches. More recently, the dimensional approach has also been applied to describing and classifying situations. Similar to the Five-Factor Model, these dimensional taxonomies were typically developed by describing situations on a large number of continuous dimensions and then reducing the number of dimensions through factor analysis (Block & Block, 1981; Edwards & Templeton, 2005; Parrigon et al., 2017; Rauthmann et al., 2014; Ziegler, Horstmann, & Ziegler, 2019). Two prominent examples for taxonomies of situation characteristics are the DIAMONDS (duty, intellect, adversity, mating, pOsitivity, negativity, deception, sociality; Rauthmann et al., 2014) and the CAPTION (complexity, adversity, positive valence, typicality, importance, humor, negative valence; Parrigon et al., 2017). Although these taxonomies have been developed by independent research teams using varying methodological methods and differ in the exact number and meaning of the dimensions, most dimensions of situation characteristics can be assigned to one six major domains (Rauthmann & Sherman, 2018): overcoming external threats (Domain I; e.g., adversity, deception dimensions in DIAMONDS; negative valence in CAPTION); dealing with internal negative events that may cause distress (Domain II; negativity in DIAMONDS; adversity in

CAPTION); completing some important or urgent task (Domain III; duty in DIAMONDS; importance in CAPTION); using deep cognitive processing (Domain IV; intellect in DIAMONDS; complexity in CAPTION), fun and pleasant situations (Domain V; mating, positivity, sociality in DIAMONDS; positive valence, humor in CAPTION); and novelty and expectability (Domain VI; typicality in CAPTION).

Given the conceptual overlap between MLEs and situations (see above), these dimensional taxonomies might be suitable to describe characteristics of MLEs. However, there are some caveats. First, most situation taxonomies were developed based on people's ratings of the situations they were in at that very moment and were never designed to be applicable to MLEs. This focus is in line with the definition of situations as fleeting and momentary (Rauthmann, 2015), but might be unable to detect characteristics that cannot be judged on a moment-to-moment basis but rather require a broader perspective on the event. Put differently, some characteristics might not be readily applicable to describing MLEs, and other characteristics relevant for MLEs might be absent because they are not suitable to describe momentary situations. Second, as proposed by Rauthmann (2015), situation characteristics can refer to the content of a situation (*content characteristics*; e.g., duty, sociability) or to content-free aspects (*style characteristics*; e.g., typicality, valence). Most situation taxonomies focus on content characteristics and include only few style characteristics (Rauthmann & Sherman, 2018), but many of the characteristics that have been discussed in the MLE literature are style characteristics (e.g., controllability or intensity of an event). Hence, while it might be possible to characterize MLEs using existing taxonomies of situation characteristics, these taxonomies appear suboptimal in order to explain how MLEs are related to long-term changes in psychological outcomes. We therefore decided to develop a novel taxonomy of characteristics of MLEs independently from situation taxonomies and later examine to what extent our independent taxonomy of characteristics of MLEs converges

with existing taxonomies of situation characteristics conceptually (Studies 1 and 2) and empirically (Study 4).

In summary, we argue that the dimensional approach should be preferred over the typological approach to describe differences among MLEs because it has several advantages. First, it permits empirical conclusions about which event characteristics are psychologically meaningful and which ones are not. Second, these conclusions can be generalized across different types of MLEs. For example, predictability of an event might generally be more strongly associated with SWB than valence, regardless of the specific MLE. Third, this approach takes into account that MLEs may look similar to observers but can be perceived very differently by those who experienced them. By assessing how individuals perceived the MLE, we can take this source of individual differences into account. Finally, prospective longitudinal studies on MLEs are easier to conduct because it is not necessary that all participants experience the exact same MLE, as long as their perceived event characteristics are measured.

The Present Paper

In this paper, we developed and tested a novel dimensional taxonomy of perceived characteristics of MLEs. We first identified characteristics discussed in the scientific literature on MLEs (Study 1) which informed the item development process (Study 2). Analyzing these items with different statistical methods such as exploratory and confirmatory factor analyses and item response theory (Studies 2 to 4), we identified nine empirically distinguishable characteristics of MLEs that could be measured reliably with the Event Characteristics Questionnaire (ECQ). We examined overlap between the ECQ dimensions and the situation characteristics measured in the DIAMONDS (Rauthmann et al., 2014) conceptually (Studies 1 and 2) and empirically (Study 4). Finally, we explored whether the ECQ dimensions could explain individual differences in changes in subjective well-being after MLEs using

retrospective (Studies 3 and 4) and prospective longitudinal data (Study 5). Data and R scripts for all empirical studies are available at <https://osf.io/g4uyx/>.

Study 1: Systematic Literature Review

The goal of Study 1 was to provide a structured overview of characteristics of MLEs that had previously been discussed in the literature. For this purpose, we conducted a systematic literature search in psychological and transdisciplinary databases (PsycINFO, Psynindex, Google Scholar) using the search terms *life events & (propert*, characteristic*, taxonomy, dimension*, attribut*)*. Furthermore, we scanned the reference lists of classical and recent theoretical articles and reviews (e.g., Brim & Ryff, 1980; B. P. Dohrenwend, 2006; Filipp, 1990; Filipp & Aymanns, 2010) (backward search) and searched for papers citing these articles (forward search). We focused on those publications that, as best as we could tell, proposed original taxonomies instead of just citing someone else's taxonomy. Table 1 summarizes the methodological approaches used in the respective publications and the event characteristics identified through these approaches. The identified characteristics of MLEs were structured by grouping characteristics that referred to the same or a similar overarching concept.¹

Methodological Approaches to Identify Event Characteristics

The references in Table 1 are ordered chronologically to provide a sense of how taxonomies of event characteristics evolved over time. Systematic research on MLEs started

¹ The categories presented in Table 1 were developed in a multi-stage process in which the authors and a research assistant independently developed and revised the category system. Specifically, the third author developed a first category system and conducted a first classification of characteristics mentioned in the literature that was available to them at the time. This classification was revised and extended (i.e., more references were added) by a research assistant independently from the third author. This second classification was then again reviewed and revised by the first author. All researchers worked independently and consulted the original literature. All authors agreed on the final version of Table 1.

with the publication of the Social Readjustment Scale (Holmes & Rahe, 1967), which distinguished MLEs on a single continuous dimension: the level of readjustment required by an event. One remarkable feature of this scale is that it includes both undesirable and desirable events. The publication of this scale inspired the development of dozens of refined approaches to measure and classify MLEs, mostly in the late 1970s and 1980s, with refinements concerning both the content (i.e., which MLEs are included) and the characteristics used to distinguish among MLEs. As one can see in Table 1, the number and content of proposed event characteristics vary substantially among these different approaches.

Table 1. Overview of event characteristics discussed in previous research

Publication	Year of publication	Methodological approach			Identified Event Characteristics								
		Only negative events?	Rate own or other people's events?	Method to identify characteristics	Valence	Attribution of causes/ controllability	Anticipation	Familiarity	Intensity and frequency	Adjustment and change	Emotional significance, stress	Domains	Other characteristics
(Holmes & Rahe, 1967)	1967	No	Hypothetical	A priori						Social readjustment			
(Paykel, Prusoff, & Uhlenhuth, 1971)	1971	No	Hypothetical	A priori							Upsettingness		
(B. S. Dohrenwend, 1973)	1973	No	Hypothetical (ratings made by judges)	A priori	Gain vs. Loss					Life change			
(Brown & Harris, 1978)	1973	No	Real	A priori (interview)			Preparation for the event			Severity of threatening implications			Implications of the event for the person's future
(B. S. Dohrenwend & Dohrenwend, 1974)	1974	No	Hypothetical (ratings made by researchers)	Not specified	Positive vs. Negative	Controllable vs. Uncontrollable	Expected vs. Unexpected		Chronic vs. Acute				
(Vinokur & Selzer, 1975)	1975	No	Real	A priori	Desirability					Pressure and adjustment evoked by life event			
(Lundberg & Theorell, 1976)	1976	No	Both	A priori						Adjustment	Upset		
(Tennant & Andrews, 1976)	1976	No	Hypothetical	A priori						Life change	Emotional distress		
(B. S. Dohrenwend, 1977)	1977	No	Unclear	A priori		Controllability	Anticipation						

Publication	Year of publication	Methodological approach			Identified Event Characteristics								
		Only negative events?	Rate own or other people's events?	Method to identify characteristics	Valence	Attribution of causes/ controllability	Anticipation	Familiarity	Intensity and frequency	Adjustment and change	Emotional significance, stress	Domains	Other characteristics
(Ruch, 1977)	1977	No	Hypothetical	Smallest space analysis (nonmetric multidimensional scaling technique)	Desirability of life change					Degree of life change		Area of life change	
(Tennant & Andrews, 1977)	1977	No	Hypothetical	A priori		Chance Self Others							
(Sarason, Johnson, & Siegel, 1978)	1978	No	Real	A priori	Positive vs. Negative					Perceived impact at the time of occurrence			
(Fairbank & Hough, 1979)	1979	No	No data	Theoreticalpaper		Within a subject's control (reflective of superior or inferior functioning) vs. Beyond a subject's control (socially desirable or undesirable)							
(Fontana, Hughes, Marcus, & Dowds, 1979)	1979	No	Real	A priori	Desirability	Control	Anticipation			Adjustment			
(Redfield & Stone, 1979)	1979	No	Hypothetical	PCA of life events and scales	Desirability					Change	Meaningfulness	Personal catastrophe Achievement Domesticity	

Publication	Year of publication	Methodological approach			Identified Event Characteristics								
		Only negative events?	Rate own or other people's events?	Method to identify characteristics	Valence	Attribution of causes/ controllability	Anticipation	Familiarity	Intensity and frequency	Adjustment and change	Emotional significance, stress	Domains	Other characteristics
(Sandler & Ramsay, 1980)	1980	No	Hypothetical	PCA	Positive events							Loss Entrance Family troubles Primary environment change Sibling problem Physical harm	
(Brim & Ryff, 1980)	1980	No	Theoretical paper	Theoretical paper			Likelihood of occurrence	Age-relatedness					Social distribution
(McFarlane, Norman, Streiner, Roy, & Scott, 1980)	1980	No	Real	A priori	Desirability	Control	Anticipation			Amount of required adjustment			
(Finlay-Jones & Brown, 1981)	1981	Yes	Real (ratings made by researchers)	A priori								Danger Loss	
(Schmid, Scharfetter, & Binder, 1981)	1981	No	Real	A priori								Changes in personal roles, job, housing, social relationships, health, etc.	
(Filipp, 1981)	1981	No	Theoretical paper	Theoretical paper	Desirability (Erwünschtheit)	Controllability (Kontrollierbarkeit)	Predictability (Vorhersehbarkeit)	Timing within the life course (zeitliche Sequentierung)	Duration (zeitliche Erstreckung) Impact (Wirkungsgrad, Wirkungsbreite)	Challenge (Herausforderung), loss (Bedrohung)	Significance (Bedeutung)	Life domains (Lokalisierung im Lebensraum)	Universality (Universalität)
(Gräser, Esser, & Saile, 1981)	1981	No	Hypothetical	PCA	Desirability						Significance		Coping activities

Publication	Methodological approach				Identified Event Characteristics								
	Year of publication	Only negative events?	Rate own or other people's events?	Method to identify characteristics	Valence	Attribution of causes/ controllability	Anticipation	Familiarity	Intensity and frequency	Adjustment and change	Emotional significance, stress	Domains	Other characteristics
(Paykel, 1983)	1983	No	Real	A priori					Objective negative impact			Independence (from psychiatric illness)	
(Reese & Smyer, 1983)	1983	No	Hypothetical (ratings by authors)	Systematic literature review	Desirability	Control	Expectation Likelihood	Age-relatedness Prevalence	Reversibility Timing	Impact			Focus (Self vs. Other)
(Chan, Chan-Ho, & Chan, 1984)	1984	No	Hypothetical	A priori	Desirability	Uncontrollability				Adjustment	Upsettingness		
(Cochran & Hammen, 1985)	1985	Yes	Real	A priori		Perceived control Globality Locus Stability Intentionality					Degree of upset		
(Lewinsohn, Mermelstein, Alexander, & MacPhillamy, 1985)	1985	Yes	Real	PCA of life events		Controllable vs. Uncontrollable			Major vs. Minor	Life changes		Self vs. Others Death-related Legal Sexual-marital- friendship	
(Miller & Ingham, 1985)	1985	No	Real	A priori								Loss Threat Anti-social act	Choice of action Uncertain outcome Hopeless
(Smith & Ellsworth, 1985, 1987)	1985	No	Real (but only emotional situations, not life events)	PCA and Multidimensional Scaling	Pleasantness	Responsibility/ control		Certainty		Anticipated effort			Attention

Methodological approach					Identified Event Characteristics								
Publication	Year of publication	Only negative events?	Rate own or other people's events?	Method to identify characteristics	Valence	Attribution of causes/ controllability	Anticipation	Familiarity	Intensity and frequency	Adjustment and change	Emotional significance, stress	Domains	Other characteristics
(Davis & Compas, 1986)	1986	No	Hypothetical	A priori	Desirability	Locus of cause Controllability of cause Stability of cause Generality of cause	Predictability		Impact Frequency	Ability to cope			Degree to which others could be of help in coping with this event
(Fish, 1986)	1986	No	Hypothetical	EFA	Evaluation						Emotional response		
(Gall & Evans, 1987)	1987	No	Real (but no event-specific ratings)	EFA	Undesirability/threat			Familiarity		Gain/ challenge			Need for information Need to accept
(Headey & Wearing, 1989)	1989	No	Real (but rated by researchers)	A priori	Positive vs. Negative								
(Gorman & Peters, 1990)	1990	No	Real (but rating about the event was made by researchers)	A priori	Loss	Independence				Danger			
(Reisenzein & Hofmann, 1990)	1990	No	Hypothetical (not just life events, but emotional situations more generally)	Repertory grid technique	Valence	Perceived control Causality, agency, intentionality Responsibility, blame, moral evaluations Activity vs. Inactivity		Expectedness /familiarity	Temporal aspects (future vs. Past vs. Present, beginning vs. End, etc.)		Importance	Social relationship aspects	Focus on self vs. Others
(Sheets, Sandler, & West, 1996)	1996	Yes	Real	CFA		Self Others						Material loss	
(Ferguson, Matthews, & Cox, 1999)	1999	Yes	Real	EFA	Threat Loss					Challenge			

Publication	Year of publication	Methodological approach			Identified Event Characteristics								
		Only negative events?	Rate own or other people's events?	Method to identify characteristics	Valence	Attribution of causes/ controllability	Anticipation	Familiarity	Intensity and frequency	Adjustment and change	Emotional significance, stress	Domains	Other characteristics
(B. P. Dohrenwend, 2000)	2000	Yes	No data	Theoretical paper	Valence	Source / fatefulness	Predictability		Magnitude		Centrality		Physical exhaustion
(Kendler, Hettema, Butera, Gardner, & Prescott, 2003)	2003	Yes	Real (but ratings made by others)	A priori								Categories: loss, danger, entrapment, humiliation	
(Hasan & Power, 2004)	2004	Yes	Real	EFA	Threat Gain	Self-Blame External blame	Predictability				Significance		
(Göral, Kesimci, & Gençöz, 2006)	2006	Yes	Real (but rating about event characteristic was made by researchers)	A priori		Controllability							
(Wilson & Gilbert, 2008)	2008	No	No data	Theoretical paper		Explanatory coherence	Surprise Certainty	Novelty Variability					
(Filipp & Aymanns, 2010)	2010	No	No data	Theoretical paper	Loss (Verlustthematik)	Controllability (Kontrollierbarkeit)	Anticipation (Vorhersehbarkeit) and surprise (Überraschungsehalt)	Normative vs. Non-normative (normative vs. Non-normative Ereignisse)	Disruption of person-environment fit (Schädigung der Person-Umwelt-Passung) Effect on multiple life domains (Wirkungsgrad)	Change in world views (Erschütterung des Weltbildes) Change in self-image and self-esteem (Erschütterung des Selbstbildes und Selbstwertbezug)	Affective consequences (Affektiver Gehalt)		Goal relevance (Zielrelevanz) Effect on others (Systemreferenz)

Publication	Year of publication	Methodological approach			Identified Event Characteristics								
		Only negative events?	Rate own or other people's events?	Method to identify characteristics	Valence	Attribution of causes/ controllability	Anticipation	Familiarity	Intensity and frequency	Adjustment and change	Emotional significance, stress	Domains	Other characteristics
(Motrico et al., 2013)	2013	Yes	Real	PCA									Spousal and relational problems Employment and financial problems Personal problems Illness and bereavement in close persons
(Gentzler, Ramsey, Yi, Palmer, & Morey, 2014)	2013	No	Real (but rating about event characteristic was made by researchers)	A priori					Duration				10 life domains, including recreation/leisure, school, friends, etc.
(Bhattacharjee & Mogilner, 2014)	2014	No	Real	A priori				Ordinary vs. Extraordinary					
(Buccheri, Musaad, Bost, & Fiese, 2018)	2018	No	Real	EFA									Social and financial readjustment Change in habits and family dynamics Social misconduct and work-time challenges Death and change in relationships

Notes. EFA = Exploratory factor analysis. CFA = Confirmatory factor analysis. PCA = Principal component analysis. Two publications were in German (Filipp, 1981; Filipp &

Aymans, 2010). For these publications, we list the original characteristics in German as well as our English translations.

To structure these approaches, it is helpful to distinguish between taxonomies of life event characteristics that were based on *a priori* assumptions and taxonomies that were identified using data analytic techniques such as exploratory factor analysis (see Column “Method to identify characteristic” in Table 1). Taxonomies based on *a priori* assumptions were often, but not always, derived from elaborated theoretical frameworks such as appraisal theory (Folkman & Lazarus, 1985; Lazarus & Launier, 1978), attribution theory (Harvey & Weary, 1984; Kelley & Michela, 1980), and life-stress approaches such as the one first proposed by Holmes and Rahe (1967) and extended by the Dohrenwend’s (B. S. Dohrenwend & Dohrenwend, 1974). In addition, approaches can be distinguished in terms of whether they included both undesirable and desirable events or whether they focused exclusively on undesirable events (see Column “Only negative events” in Table 1). An exclusive focus on undesirable events is often found in clinical approaches and justified with the observation that desirable events have no predictive validity for clinical disorders such as depression and anxiety (Hammen, 2005).

Identified Event Characteristics

The main aim of this literature review was to identify all dimensions of event characteristics that had previously been proposed in the literature. In Table 1, we assigned these characteristics into different categories. Before we describe the different categories in detail, we need to make two general notes. First, for each reference, we kept the original terminology. This terminology was inconsistent across publications such that different terms were used to describe the same general concept and the same terms were used to describe different concepts. For example, the terms “loss” and “threat” have been used by some authors to refer to quantitative characteristics (e.g., the extent of loss associated with an event; Ferguson et al., 1999) and by others to distinguish different types of events (e.g., loss events vs. threat events; Miller & Ingham, 1985). Second, because we planned to develop a

dimensional taxonomy, we were mainly interested in characteristics that could be conceptualized as continuous, independent dimensions (quantitative characteristics) rather than as mutually exclusive categories (qualitative characteristics). Some of the references included in this table used terms such as “dimensions” to describe mutually exclusive categories (e.g., B. S. Dohrenwend & Dohrenwend, 1974; Fairbank & Hough, 1979; Finlay-Jones & Brown, 1981). These categories often referred to different life domains (e.g., Buccheri et al., 2018; Motrico et al., 2013; Redfield & Stone, 1979). We included these references in the table, but did not further consider them when developing the items for our dimensional taxonomy.

We identified 7 distinguishable and interpretable continuous characteristics. (1) *Valence* was one of the most frequently discussed characteristics and describes to what extent an event is desirable/positive vs. undesirable/negative. (2) *Controllability and Attribution* refers to the extent to which the person experiencing the event had some control over whether, when, or how the event occurred or attributed the event to internal or external factors. Note that some authors (e.g., Cochran & Hammen, 1985; Davis & Compas, 1986) proposed multiple dimensions of attributions of MLEs which we all subsumed under this general category. (3) *Anticipation* of the event is somewhat related to its controllability and refers to whether the event was predictable or came as a surprise. Anticipation is distinct from (4) *Familiarity*, which refers to whether people had had some prior exposure to the event, for example because they had personally experienced the event before or because it is an ordinary event for which normative response schemata are available.

The final three characteristics are not characteristics of the event itself but refer to its consequences and impact. (5) *Intensity and Frequency* reflect the observable impact and duration of the event. This characteristic is more objective than the next two characteristics, which reflect the subjective experience. (6) *Adjustment and Change* is based on Holmes and Rahe’s (1967) concept of social readjustment and refers to the level of coping that is required

when experiencing a certain event. This level is often operationalized in terms of the length of time it takes to adjust to the event. (7) *Emotional Significance* reflects the emotional impact and stressfulness of an event. This characteristic is mostly applied to negative life events (e.g., degree of upsettingness of an event; Chan et al., 1984) but can also be applied to positive life events (e.g., how significant is an event).

Table 1 also contains other characteristics for which we were not able to identify a general category (see Column “Other”). The characteristics listed in this column are not necessarily irrelevant; they have merely been discussed less frequently in the literature than the characteristics listed in the other columns.

Summary

Once characteristics distinguishing life domains and characteristics referring to categories rather than to continuous dimensions are dropped, most the remaining characteristics can be grouped into one of seven broad dimensions: valence, controllability and attribution, anticipation, familiarity, intensity and frequency, adjustment and change, and emotional significance. Importantly, these dimensions only emerged through the integration of multiple studies, but none of these taxonomies satisfied all of the desired features of a dimensional taxonomy that we outlined in the introduction. For example, a substantial proportion of the studies listed in Table 1 focused on adverse MLEs. While the focus on adverse MLEs is appropriate in order to explain clinical outcomes such as depression or anxiety (B. P. Dohrenwend, 2006; Monroe, 2008), taxonomies based on negative MLEs only may be incomplete and neglect important dimensions that may be relevant to explain changes in non-clinical outcomes such as SWB or personality traits. Furthermore, no single empirical study had identified all seven dimensions, and only few studies had proposed characteristics that tapped into four or more of these dimensions. Those taxonomies that comprised more than four dimensions were mostly based on data-driven approaches in which participants

rated real instead of hypothetical MLEs. However, only three of these data-driven approaches included positive events (Buccheri et al., 2018; Gall & Evans, 1987; Smith & Ellsworth, 1985), but these approaches had other limitations such as describing one's general situation (Gall & Evans, 1987) or specific emotional events (Smith & Ellsworth, 1985) rather than specific MLEs, or using a typological instead of a dimensional approach (Buccheri et al., 2018).

Hence, despite decades of research, a broad and empirically validated taxonomy of continuous MLEs characteristics that applies to a wide range of different MLEs is still missing. Could this gap be filled by existing taxonomies of situation characteristics? In Table 2, we marked those DIAMONDS and CAPTION dimensions that overlap conceptually with the event characteristics identified in Study 1. Three patterns are particularly notable. First, three of the six broad domains of situational characteristics are related to valence, suggesting that valence is a complex dimension that might differentiate into different facets. Second, Domain VI, which is represented by the typicality dimension of the CAPTION model, is conceptually related to at least two characteristics of MLEs (anticipation and familiarity), suggesting that this domain may require more differentiation for MLEs than for situations. Finally, controllability/attribution and intensity/frequency, two event characteristics that are frequently discussed in the literature on MLEs, show no obvious conceptual convergence with any of the situation characteristics, indicating that some characteristics that are relevant for MLEs are absent in existing taxonomies of situation characteristics. Overall, most event characteristics are style characteristics whereas most situation characteristics are content characteristics (Rauthmann, 2015). In sum, despite some conceptual overlap, existing taxonomies of situation characteristics cannot readily be applied to descriptions of MLEs, indicating the need for developing a novel taxonomy of characteristics of MLEs.

Table 2. Conceptual similarities and differences between characteristics of major life events identified in Studies 1 and 2 and characteristics of situations proposed by the DIAMONDS and CAPTION models

[illegible]

[illegible]

			Domain I: overcoming external threats		Domain II: dealing with internal negative events that may cause distress		Domain III: completing some important or urgent task		Domain IV: using deep cognitive processing		Domain V: situations that are fun and pleasant					Domain VI: novelty and expectabilit y of situations		
			DIAMON DS	TIO N	DIAMONDS		DIAMON DS	CAPTIO N	DIAMONDS		DIAMONDS		CAPTION		CAPTION			
			Adversity	Deception	Negative valence	Negativity	Adversity	Duty	Importance	Intellect	Complexity	Mating	Positivity	Sociality	Positive valence	Humor	Typicality	
Study	Event characteristic	Description																
		associated with the event																
Study 2	Emotion al significa nce	Extent to which the event elicited strong feelings			X				X									
Study 2	Change in World View	Extent to which one’s views have changed due to the event																
Study 2	Social status change	Extent of changes in one’s social status and dependence on others											X					
Study 2	External control	Extent to which the event was controlled or caused by others	X															
Study 2	Extraord inariness	Extent of how ordinary or extraordinary the event was																X

Notes. X marks characteristics that overlap conceptually.

Study 2: Item Development and Factorial Structure

In Study 2, we developed an initial item pool and analyzed these items in order to (a) empirically identify the most relevant dimensions of event characteristics using exploratory factor analysis, and (b) to select those items from the initial item pool that measured these dimensions best. Note that the items were developed in German and tested in German-speaking populations; English translations provided in this paper have not yet been validated in English-speaking populations.

Methods

Sample and Procedure

Recommendations for the appropriate sample size for exploratory factor analyses vary greatly among references (Fabrigar, Wegener, MacCallum, & Strahan, 1999; Goretzko, Pham, & Bühner, 2019; MacCallum, Widaman, Zhang, & Hong, 1999). For our study, we expected that factors would probably be overdetermined (i.e., multiple items loading on one factor) due to the large number of items in our item pool. Following the rules of thumb provided by MacCallum et al. (1999), we therefore set the minimum sample size to $N = 200$ but continued data collection until a pre-specified date was reached to aim for a larger sample size that is closer to the $N = 300$ to 400 recommended in more recent publications (e.g., Goretzko et al., 2019). Participants were recruited through various online forums, Facebook groups, and email lists of people interested in participating in psychological studies (for details, see supplemental material). As compensation, all participants received feedback on their individual personality profile. Psychology students additionally received course credit for their participation. The final sample comprised $N = 449$ adult participants (81.5% female, $M_{\text{age}} = 26.1$, $SD_{\text{age}} = 10.1$, 15.4 % college students).

The online questionnaire was implemented in Qualtrics. After providing informed consent and passing the age verification, participants were asked to recall an MLE from any life domain that had occurred in the past 24 months. The instructions did not provide any direction with respect to the valence of the MLE but specified that the MLE should be personally important and have a clear date. After naming the MLE in a short open format, participants then checked all life domains that this event involved, provided the time that had passed since the event in weeks and months, and rated the event on 57 items (see next section). Participants then completed measures of personality (used for the personality feedback) and SWB (not used for the present analyses) and provided demographic information.

Data for study were collected at the University of Cologne in 2015, which at the time did neither require nor offer ethics reviews for empirical studies. However, this study used a similar design as Studies 3 and 4 for which IRB approval could be obtained, and complied with common ethical guidelines for psychological research.

Measures

To develop the initial item pool, we focused on the seven dimensions of event characteristics identified in Study 1. The item development process was additionally informed by the results of a small qualitative study that we describe in detail in the supplemental material (Study 1b). The purpose of Study 1b was to ensure that our taxonomy comprised not only characteristics discussed in the scientific literature, but also characteristics relevant to those who actually experience the events, and to inform the wording of the items. Whenever possible, we developed both positively and negatively worded items. The initial item pool comprised 57 items (for details on the item development process and a complete list of all initial items, see supplemental material). All items were rated on a 5-point scale ranging from 1 (*does not apply at all*) to 5 (*applies completely*) and presented in random order.

Data analysis

The data were analyzed using exploratory factor analysis (EFA). Because the items were rated on a discrete scale (five discrete response options), all analyses were based on polychoric correlations. The number of factors was determined using parallel analysis and Velicer minimum average partial (MAP) test. MAP was computed for up to 15 factors, and the solution providing the lowest MAP was selected (Revelle, 2017). When these methods differed in the number of suggested factors, different factor solutions were computed and compared. Priority was given to factor solutions with a simple structure (i.e., high number of items with high loadings on exactly one factor and low loadings on all other factors) and interpretability of the factors. Only factor loadings $> |.40|$ were interpreted. Factors were extracted using the minres method with oblimin rotation (Revelle, 2017). Analyses were conducted with the functions `fa.parallel` (for parallel analysis), `VSS` (for MAP), and `fa` (for EFA) of the R package `psych` (Revelle, 2017).

Following the suggestions by a reviewer, we subsequently probed the robustness of the factor solutions across two additional factor analytic methods. We used *bass-ackwards* EFA (Goldberg, 2006) to visually compare different factor solutions, and bifactor EFA as implemented in the `omega` function of the `psych` package (Revelle, 2017) to examine to what extent controlling for a general factor changed the obtained factor solutions. Both additional analyses led to the same conclusions as the main analyses reported below. Details on these additional analyses are reported in the supplemental material.

Results

Parallel analysis (see Figure S7) and MAP suggested that the optimal number of factors was between 7 (principal axis parallel analysis) and 9 (principal component parallel analysis, MAP). We therefore ran three EFAs in which we extracted 7, 8, and 9 factors (Table 3 and Tables S5 and S6), respectively, and compared the factor solutions with respect to (a)

number of items with simple loadings and (b) interpretability of the factors. The number of items with a factor loading $> |.40|$ and no double loadings was highest for the 9-factor solution (51 items) and lowest for the 8-factor solution (47 items), somewhat favoring the 9-factor solution over the others. All three factor solutions yielded clearly interpretable factors. The 7-factor solution included one very broad factor that comprised almost half of all items, all of which referred to the general valence of the MLE. This factor was split up into two factors in the 8-factor solution, one referring to general valence and the other referring more specifically to stressful and challenging aspects of the event. Extracting 9 instead of 8 factors left the factors identified in the 8-factor solution intact but added a factor that comprised items reflecting the degree of extraordinariness versus ordinariness of the MLE. These items did not load on any other factors in the previous factor solutions. Because extraordinariness is a dimension that had been discussed in the literature as potentially important (Bhattacharjee & Mogilner, 2014), we decided to base the next steps in the scale development on the 9-factor solution.

The pattern matrix containing the standardized factor loadings for the 9-factor solution is presented in Table 3. Factor 1 comprised items referring to positive and negative aspects of the event and was labeled *Valence*. Factor 2 comprised items referring to the extent to which one's life has changed due to the event and was labeled *Impact*. Factor 3 was characterized by two items referring to how suddenly or predictably the event had occurred and was labeled *Predictability*. Factor 4 comprised items referring to the amount of stress and anxiety associated with the event and was labeled *Challenge*. Factor 5 was characterized by two items referring to the emotional significance of the event and was labeled *Emotional Significance*. Factor 6 comprised three items referring the how much one's views have changed due to the event and was labeled *Change in World Views*. Factor 7 comprised two items referring to changes in one's social status and dependence on others and was labeled *Social Status Change*. Factor 8 was characterized by two items referring to the extent to which the event

was controlled or caused by others and was labeled *External Control*. Finally, Factor 9 comprised items referring to how ordinary or extraordinary the event was and was labeled *Extraordinariness*.

Table 3. Standardized factor loadings for the 9-factor solution in Study 2.

No.	Item wording (translation)	Factor 1: Valence	Factor 2: Impact	Factor 3: Predictability	Factor 4: Challenge	Factor 5: Emotional significance	Factor 6: Change in world views	Factor 7: Change in social status	Factor 8: External control	Factor 9: Extraordinar iness
39	The event made me hopeful.	.96	-.02	-.06	.03	.11	.10	.02	-.01	-.02
23	The event was joyful.	.93	.00	.04	-.12	.03	-.03	.07	-.03	-.01
3	The event was positive.	.93	.01	.07	-.09	-.02	-.04	.06	.01	-.01
37	The event gave me courage.	.90	.01	-.04	.02	.05	.10	-.01	-.03	.07
1	The event was beneficial.	.90	.04	.03	-.01	.02	.03	-.01	-.02	.02
24	The event was sad.	-.89	-.06	-.02	.10	.19	.14	-.11	.00	.01
4	The event was negative.	-.88	-.01	-.11	.11	.05	.04	.01	.04	-.01
33	The event made me proud.	.88	.06	.04	.05	.00	.09	-.11	.04	-.03
2	The event was a loss.	-.86	.09	.01	.03	.12	.11	-.08	-.05	-.06
28	The event gave me strength.	.85	-.03	-.03	-.04	.13	.18	-.07	-.02	.08
31	The event was a disappointment.	-.78	-.07	.03	.15	.02	.13	.07	.12	.04
38	The event made me feel hopeless.	-.75	.00	.00	.19	.11	.17	.10	.03	.03
30	The event calmed me.	.67	-.07	.09	-.24	.03	.14	.01	-.05	.03
47	The event improved my social status.	.66	.18	-.01	.17	-.17	.08	-.20	.14	-.09
32	The event was humiliating.	-.64	-.06	.03	.17	-.06	.28	.10	.20	.18
13	The event had a purpose.	.64	.09	.26	.13	-.03	.05	-.13	.10	-.01
7	I bear responsibility for the event.	.62	-.02	.39	.29	-.09	.16	.11	-.13	.05
9	The event was on purpose	.57	-.04	.50	.16	-.02	-.01	.01	.18	.02
5	I was able to control the event.	.55	-.06	.34	.15	-.13	.13	-.11	-.06	.05
52	The event led to psychological problems.	-.51	.17	.01	.25	.07	.13	.27	.03	.03
35	The event relieved me.	.47	-.14	.14	-.19	.01	.36	-.19	-.02	.04
29	The event was a threat.	-.46	.00	-.15	.39	-.10	.13	.11	-.03	.07
50	The event liberated me.	.46	.04	.07	.06	-.14	.45	-.44	.00	.06
45	The event improved my social relationships.	.28	.17	-.06	-.20	.13	.24	-.23	.08	.03
18	The event had many effects on my life.	.11	.81	-.04	.00	.11	-.04	.07	-.01	.06
17	The event had a strong impact on my life.	.08	.74	.03	.01	.16	.02	.02	-.11	.04

No.	Item wording (translation)	Factor 1: Valence	Factor 2: Impact	Factor 3: Predictability	Factor 4: Challenge	Factor 5: Emotional significance	Factor 6: Change in world views	Factor 7: Change in social status	Factor 8: External control	Factor 9: Extraordinar iness
19	The event had long-term consequences.	-.18	.73	.23	-.14	.10	-.18	-.06	-.06	.16
14	I had to change my life due to the event.	.09	.70	.02	.23	-.05	.06	.10	.07	-.10
44	The event led to changes in my social, family, or work roles.	-.06	.70	.00	.00	-.19	.18	-.09	-.01	-.01
16	The event had few effects on my daily life.	-.16	-.67	.14	-.14	.04	.04	-.07	-.07	.08
20	The event affected different domains in my life.	.02	.63	.11	.06	-.05	.20	.02	-.02	.05
54	The event triggered other meaningful events.	.05	.52	-.04	-.12	.01	.32	.00	.01	.13
15	The event destabilized my daily life.	-.24	.45	-.20	.18	.13	.05	.14	.09	-.12
11	The event was predictable.	-.14	.00	.90	.00	.06	.03	-.04	.01	-.08
10	The event was surprising.	.01	-.07	-.89	.03	.06	.05	.01	.03	.04
12	The event occurred suddenly.	-.11	.00	-.81	.06	.06	.05	-.07	.01	.05
25	The event was a challenge.	.18	.21	-.03	.72	.09	-.04	-.16	-.06	.05
34	The event was stressful.	-.25	.09	.13	.69	.04	-.01	-.04	.12	.05
36	The event scared me.	-.32	.01	-.15	.62	.09	.03	.06	-.03	-.02
27	The event exhausted me.	-.42	.08	.06	.54	.14	-.03	.09	-.01	-.07
26	The event overburdened me.	-.39	.07	-.14	.46	.19	.04	.16	.00	-.03
22	The event was emotionally significant to me.	.11	.08	.06	.01	.88	.02	.00	.00	.01
21	The event elicited strong feelings.	-.03	-.01	-.07	.11	.81	-.01	.02	.04	.11
53	I remember the event frequently.	-.04	-.08	-.03	-.03	.60	.23	.12	-.14	.07
56	The event changed my self-image.	.16	.12	-.03	.02	.17	.73	.06	.10	-.07
55	The event changed my world views.	-.18	.29	-.14	-.10	.14	.62	-.04	.02	-.14
57	The event shattered my world view.	-.39	.03	-.25	.09	.09	.42	.14	-.03	-.04
46	The event impaired my social relationships.	-.29	.10	.21	.10	-.08	.34	.33	.13	.18
49	The event made me more dependent.	.25	.06	-.01	-.09	.07	-.02	.89	.02	-.03
48	The event impaired my social status.	-.33	.09	.08	.08	-.19	.31	.44	-.05	.22
51	The event led to physical problems.	-.27	.19	-.07	.25	-.04	.14	.41	-.02	-.09
6	Others were able to control the event.	.09	-.07	.06	.10	-.01	-.04	-.02	.87	-.11
8	Others bear responsibility for the event.	-.09	.03	-.07	-.19	.01	.03	.02	.87	.13

No.	Item wording (translation)	Factor 1: Valence	Factor 2: Impact	Factor 3: Predictability	Factor 4: Challenge	Factor 5: Emotional significance	Factor 6: Change in world views	Factor 7: Change in social status	Factor 8: External control	Factor 9: Extraordinar iness
40	The event was ordinary.	.09	-.07	.02	-.02	-.16	.20	.19	-.03	-.72
41	The event was extraordinary.	.14	.06	-.13	.00	.15	.01	.05	.03	.68
43	People like me experience this or similar events as well.	-.12	.04	.27	-.01	.23	-.05	-.29	.03	-.52
42	I have previously experienced this or a similar event.	-.21	.00	.13	-.26	.07	.02	.12	-.05	-.27

Notes. Factor loadings $\geq |.40|$ are printed in bold face. Factor loadings $< |.40|$ are not further interpreted. For original German item wordings, see Table S2.

Summary

We identified nine distinct, clearly interpretable factors. Most of these factors reflected dimensions identified in the systematic literature search in Study 1 (e.g., valence, emotional significance, impact); however, there were also some factors that had not been broadly discussed in the previous literature but rather evolved from lay descriptions of MLEs (Study 1b), for example, change in world views and change in social status. Mirroring Study 1, six factors referred to characteristics of the MLE itself (valence, predictability, challenge, emotional significance, external control, extraordinariness) and the remaining three factors referred to the immediate consequences of the MLE (impact, social status change, change in world views). We discuss the implications of measuring both characteristics of the event itself and its perceived consequences in the General Discussion.

It is noteworthy that all items referring to the valence of the MLE loaded on one factor. Previous research on MLEs has often differentiated between positivity and negativity (e.g., B. S. Dohrenwend & Dohrenwend, 1974; Headey & Wearing, 1989) or between gain and loss (e.g., B. S. Dohrenwend, 1973; Hasan & Power, 2004). Similarly, most taxonomies of situation characteristics include at least two dimensions that refer to the valence of a situation (see Table 2). In our data, in contrast, we were not able to empirically distinguish between positive and negative characteristics of MLEs, neither in the ordinary EFA nor in a bifactor EFA (see supplemental material). This may be due to our approach of having participants rate a recalled MLE that they chose themselves. It is possible that participants were more likely to recall and report MLEs with a non-ambiguous valence. To ensure that our items are also able to describe events with ambiguous valence, we retained both items referring to positive aspects and items referring to negative aspects in all subsequent versions of the ECQ.

Table 2 compares the ECQ subscales to situation characteristics included in the DIAMONDS and CAPTION models. In addition to valence, a clear conceptual overlap between ECQ dimensions and situation characteristics was found for challenge (overlap with CAPTION negative valence and DIAMONDS negativity) and emotional significance (overlap with DIAMONDS negativity and, to a lesser extent, with CAPTION importance). In contrast, no obvious conceptual overlap could be found for impact and change in world views, both factors that refer to the perceived consequences of the MLE rather than to characteristics of the event itself. Furthermore, the ECQ dimensions predictability and extraordinariness both share commonalities with typicality of the CAPTION framework, which in turn does not differentiate between predictability and extraordinariness. In sum, this integration indicates again that taxonomies of situation characteristics overlap partly but not completely with our taxonomy of event characteristics. In Study 4, we examined this overlap empirically by investigating correlations among characteristics of MLEs and characteristics of situations.

One undesired aspect of the factor solution in this study was that the number of items loading on each factor varied widely among factors: more than 20 items had loadings $> |.40|$ for Factor 1 (Valence) but only two items had loadings $> |.40|$ for Factor 8 (External Control). To ensure that each factor could be measured reliably, one objective for the next studies was to reduce the number of items for those factors that comprised multiple items and to increase the number of items for those factors that comprised only few items.

Studies 3 and 4: Item Revision and Associations with Retrospective Changes in SWB After MLEs

The goals of Studies 3 and 4 were to select the final items and to provide initial evidence on the construct validity and predictive utility of the ECQ. We aimed at selecting four items for each of the 9 factors (henceforth: subscales) identified in Study 2. Four items were deemed the optimal number of items because it allowed us to model each factor

separately in an over-identified measurement model while at the same time keeping the total scale economical. For those factors for which more than 6 items had substantial loadings in Study 2, we selected those items that had the highest factor loadings and were most representative in terms of content validity. For those factors for which fewer than 6 items had substantial loadings in Study 2, we developed additional items (see supplemental material for details on the item development process). For each subscale, we had at least 6 candidate items (7 for the subscales predictability and change in world views, 56 items in total) from which we then selected the final items. The psychometric properties were examined in both studies using a combination of approaches based on classical test theory and item response theory, and those items that performed well on different approaches and in both studies were selected for the final version of the scale.

In addition, Study 3 provided initial evidence on the predictive utility of the ECQ by investigating the associations between the ECQ subscales and retrospective SWB. In particular, we tested whether the ECQ subscales explained individual differences in retrospective SWB trajectories over and above those variables that are typically investigated as predictors of individual differences in SWB trajectories: age, gender, extraversion, and neuroticism (Luhmann & Intelisano, 2018; Yap, Anusic, & Lucas, 2012). Although retrospective SWB might differ from actually experienced SWB, we expected to observe similar trajectories as those that have been reported for experienced SWB after MLEs (Luhmann, Hofmann, et al., 2012). Specifically, we expected the retrospective trajectories to differ as a function of the valence of the event such that SWB was expected to be higher than usual at positive events (positive reaction) and lower than usual at negative events (negative reaction), and then return to its pre-event level over time (adaptation). We did not have any strong hypotheses about the association between the remaining perceived event characteristics and the trajectories. We therefore explored possible interaction effects in Study 3, and then directly replicated these analyses in an independent sample in Study 4.

In Study 4, we additionally examined the convergence between the ECQ subscales and the DIAMONDS situation characteristics as an indicator of the construct validity of the ECQ. We chose the DIAMONDS as a benchmark because it is currently the most frequently used framework to assess situation characteristics and covers more dimensions than other taxonomies of situation characteristics. High convergence between the ECQ subscales and the DIAMONDS would suggest a strong conceptual and empirical overlap between characteristics of MLEs and characteristics of situations and was therefore expected for valence, challenge, and emotional significance (see Study 2). Low convergence, in contrast, would suggest that characteristics of MLEs and characteristics of situations are conceptually distinct concepts and was therefore expected for impact and change in world views (see Study 2).

Finally, Study 4 was designed to overcome two limitations of Study 3 with respect to sampling of participants and MLEs. Participants in Study 3 were on average young and predominantly female (see below), so we aimed at recruiting a sample that was more diverse in terms of age and gender for Study 4. Furthermore, participants in Study 3 were instructed to recall an MLE within the past 6 months (see below), which may have restricted the types and characteristics of MLEs included. In Study 4, we systematically varied the timeframe within which the MLE should have occurred, allowing us to examine the robustness of the findings across different timeframes.

Methods

Both studies were approved by the local ethics committee of the Ruhr University Bochum (Protocol 377 “Pursuit of happiness and life events”).

Study 3: Sample and Procedure

As detailed below, the data were analyzed with separate unidimensional confirmatory factor models with 4 to 8 indicators per model. Sample size recommendations for such models range from 40 to 190 (Wolf, Harrington, Clark, & Miller, 2013). However, considering that for many applications, estimates of correlations stabilize at $N = 250$ (Schönbrodt & Perugini, 2013), we aimed for a total sample size of $N = 250$. Adult participants were recruited through local student listservs, Facebook ads posted via our lab's Facebook page, and various online groups (for details, see supplemental material). After excluding participants who dropped out of the survey before responding to two instructed responses items (see below) ($n = 76$) or who provided false responses on either of two instructed response items ($n = 2$), the final sample was $N = 226$ (84.0 % female, $M_{\text{age}} = 25.8$, $SD_{\text{age}} = 7.6$, 56.1 % college students). As compensation, all participants were able to participate in a raffle of gift cards for a major online retailer. Psychology students additionally received course credit for their participation.

The online questionnaire was implemented in Qualtrics. After providing informed consent and passing the age verification, participants completed self-report measures of current SWB and the Big Five personality traits as well as two self-report measures of other variables (importance of happiness, acquiescence measures) not intended for the present analyses. They were then asked to recall an MLE from any life domain that had occurred in the past 6 months, using the same instruction as in Study 2.² After naming the MLE in a short open format, participants then checked all life domains that this event involved, provided the time that had passed since the event in weeks and months, and rated the perceived characteristics of this event. Next, participants provided retrospective assessments of their SWB before and after the event. Finally, demographic information was collected.

² Note that in Study 2, the timeframe was 2 years to ensure that people would report a broad range of different life events. In this study, we also collected retrospective data. To minimize the effects of memory bias, the timeframe was therefore reduced to 6 months.

Study 4: Sample and Procedure

The sample in Study 3 was predominantly female and young. It can be assumed that young women report different MLEs than other demographic groups, which may affect the internal structure and the psychometric properties of the ECQ. In Study 4, we therefore aimed to recruit a sample with a higher proportion of men and a higher average age. We determined the required sample size separately for two types of analyses, using the results of Study 3 as an indicator of expected effect sizes and data properties. The maximum sample size suggested in these power analyses was $N = 300$.³ Assuming that about 15 % of participants might provide low-quality data as indicated by the instructed response items, the total number of participants to be recruited was rounded up to $N = 350$.

Adult participants were recruited through existing email listservs of individuals interested in participating in psychological studies, through various online forums and social media ads, and through Facebook groups used by older and male individuals (for details, see supplemental material). After excluding participants who dropped out of the survey before responding to two instructed responses items (see below) ($n = 161$) or who provided false responses on these items ($n = 29$), and participants who completed the 15-20 minute survey in less than 10 minutes⁴ ($n = 31$), the final sample was $N = 373$ (64.1 % female, $M_{\text{age}} = 36.2$,

³ For the unidimensional confirmatory factor analyses, we followed Schermelleh-Engel et al. (2003) who recommended a sample size of at least $N = 300$ for models with few indicators per factor (here: 4 to 6) and non-normally distributed data. In addition, we used the R package *simr* (Green & MacLeod, 2016) to conduct power analyses for the mixed models used to investigate the association between the ECQ subscales and retrospective SWBG trajectories. As all significant three-way interaction effects in Study 4 were of similar size, we randomly picked one ECQ subscale for which this interaction had been significant (i.e., ECQ subscale *Impact*) and conducted the power analysis for the three-way interaction *Time Point* $\times$ *Valence* $\times$ *Impact*. Using *simr*, we ran a simulation study to compute how the power to detect this effect changes as a function of the number of Level 2 units (here: persons). This simulation indicates that a minimal sample size of $N = 80$ is sufficient to detect the above effect with 80 % power and $\alpha = .05$.

⁴ This cutoff was determined to be sufficiently conservative in order to omit apparent cases of fraud, in which the same participants appeared to have participated multiple times.

$SD_{\text{age}} = 14.0$, 31.9 % college students). As compensation, all participants were able to participate in a raffle of gift cards for a major online retailer. Psychology students additionally received course credit for their participation.

The online questionnaire was implemented in Qualtrics. After providing informed consent and passing the age verification, participants completed self-report measures of current SWB. They were then randomly assigned to recall an MLE from any life domain that had occurred (a) anytime in the past, (b) in the past 6 months (same as in Study 3), or (c) last week. This manipulation of the timeframe was implemented to examine whether the properties of the ECQ were robust across different timeframes (see above). After naming the MLE in a short open format, participants then checked all life domains that this event involved, provided the date of the event or the time that had passed since the event in weeks and months, and completed the ECQ with respect to this event. Next, participants provided retrospective assessments of their SWB before and after the event and rated the Big Five personality traits. Finally, demographic information was collected.

Measures

The measures were the same in Study 3 and 4 unless stated otherwise. Descriptive statistics and internal consistencies for all measures are reported in the supplemental material.

Perceived event characteristics (ECQ). Perceived event characteristics were measured with 56 items on a 5-point scale ranging from 1 (*does not apply at all*) to 5 (*applies completely*). A complete list of all originally included items is available in Table S3. Upon selecting the final 38 items (see below), scale scores for each subscale were created by reversing responses if appropriate and averaging the responses across items within each subscale.

Situation characteristics. In Study 4, the nine DIAMONDS situation characteristics were assessed with the German version of the 24-item S8* (Rauthmann & Sherman, 2016).

Some items were modified to be applicable to events instead of situations (e.g., “Die Situation könnte Stress auslösen” [The situation could elicit stress] was modified to “Das Ereignis hat Stress ausgelöst” [The event caused stress]). Items were rated on the same 5-point scale as the ECQ items, ranging from 1 (*does not apply at all*) to 5 (*applies completely*). Responses were averaged across items within each subscale.

Retrospective assessments of SWB. In Study 3, all participants were asked to assess their typical mood and life satisfaction retrospectively for four points in time (one month before the event, at the event, one month after the event, today) using a 7-point slider scale ranging from -3 (*much worse than normal*) to 0 (*normal*) to +3 (*much better than normal*). In Study 4, only participants who had been assigned to reporting an MLE anytime in the past or in the past 6 months were asked to complete these items. These assessments reflect participants’ self-perceived changes in their levels of general mood and life satisfaction. Retrospective assessments of mood and life satisfaction correlated strongly within each time point (from $r = .76$ to $.88$ in Study 3 and from $r = .75$ to $.90$ in Study 4) and were therefore averaged within each time point to form a retrospective SWB score where negative values indicate lower-than-normal SWB and positive values indicate higher-than-normal SWB.

Big Five personality traits. The Big Five personality traits were measured with the German versions of the 15-item BFI-2 XS (Soto & John, 2017) in Study 3 and the 30-item BFI-2 S (Soto & John, 2017) in Study 4 (German versions by Rammstedt, Danner, Soto, & John, 2018). Items were rated on a 5-point scale ranging from 1 (*do not agree at all*) to 5 (*agree completely*). Responses were reversed if appropriate and averaged across items within each subscale. Only extraversion and neuroticism were analyzed in the present study because these two personality traits are established correlates of SWB (Steel, Schmidt, & Shultz, 2008). We used the longer BFI-2 S in Study 4 because of concerns that the shorter BFI-2 XS may be limited in terms of reliability and validity. However, scale scores computed based on the BFI-2 S items correlated strongly with the respective scale scores computed based on the

BFI-2 XS items (range from $r = .92$ to $.94$). To ensure that the analyses of Study 3 are replicated as directly as possible in Study 4, we therefore used the BFI-2 XS scale scores in Study 4 as well.

Instructed response items. Two instructed response items in which participants were requested to select a specific response option for data quality purposes were administered towards the middle and towards the end of the surveys. Only participants who selected the requested response on both items were retained in the final sample.

Data analysis: Item Selection

The first objective of Studies 3 and 4 was to select the final items for each subscale. Items can be selected via different approaches, with some optimizing the homogeneity and reliability of the final scale and others optimizing the content validity of the scale by ensuring that the entire range of the latent variable is captured (Rammstedt & Beierlein, 2014). These approaches are sometimes in conflict because the former approaches favor items with highly similar distributions and strong inter-item correlations whereas the latter favor items with different distributions. To achieve a balance between these different goals, we employed multiple analytic strategies, combining classical test theory and item response theory approaches, and selected those items that performed well in all or most analyses across the two studies (Rammstedt & Beierlein, 2014; Sandy, Gosling, & Koelkebeck, 2014). In a first step, we estimated partial credit models (a variant of item response theory models for ordinal data) using the `gpcm` function of the R package `ltm` (Rizopoulos, 2006) to obtain item information curves for each item, and selected those items with peaks at different locations of the latent variable to ensure that the range of the latent variable is captured as broadly as possible. Note that this step sometimes resulted in the inclusion of items that did not perform optimally in terms of homogeneity (see next criteria). In cases where this step did not result in a clear decision (e.g., because the peaks of the item information curves were at similar

locations), we applied additional criteria (Sandy et al., 2014). Specifically, we favored those items that (a) were most strongly correlated with the total scale (based on a classical item analysis performed with the alpha function of the R package psych; Revelle, 2017), (b) provided maximum item information (as indicated by the partial credit model; see above), (c) had the highest loadings in a unidimensional principal components analysis (function principal in the R package psych; Revelle, 2017), and correlated similarly with external variables (here: life satisfaction, mood, Big Five personality traits, and time since event; see Sandy et al., 2014) as the total scale. In addition, we used ant colony optimization (Janssen, Schultze, & Grötsch, 2017; Leite, Huang, & Marcoulides, 2008) implemented in the antcolony.lavaan function of the R package ShortForm (Leite & Raborn, 2017) to identify four items for each subscale that yielded a good model fit.

Finally, we examined the unidimensionality of each final subscale with confirmatory factor analysis (CFA) using the WLSMV estimator to account for the ordinal level of the items. Confirmatory factor models were fitted using the cfa function available in the R package lavaan (Rosseel, 2012). To evaluate model fit, we considered the χ^2 test for the model as well as RMSEA, CFI, and TLI, with model fit considered acceptable for models with RMSEA < .08 and CFI and TLI > .95 (Schermelleh-Engel, Moosbrugger, & Müller, 2003). For subscales for which the unidimensional model provided suboptimal fit in Study 3, we further tested whether modifying the model by allowing covariances between residuals of specific items improved the model fit. In Study 4, only those models that had provided the best fit in Study 3 were evaluated without any further modifications. To determine the overall fit of the ECQ, we then combined the final measurement models into one confirmatory factor model with correlated latent variables. Mirroring the bifactor EFA applied in Study 2, we additionally planned to estimate a bifactor model with valence as a reference factor (Eid, Geiser, Koch, & Heene, 2017); however, this model provided improper solutions in both Study 3 and 4 and was therefore not further considered.

Data Analysis: Predictive Utility and Construct Validity

To provide initial evidence for the predictive utility of the ECQ, we examined whether the ECQ subscales accounted for individual differences in retrospective SWB trajectories using mixed models with time point as a four-level within-person factor and ECQ subscales and other covariates as person-level variables. Note that these analyses excluded participants who reported an MLE in the last week, because retrospective SWB was not assessed in this subgroup (see above). To model differences in trajectories as a function of valence (see above), we included the interaction between time point and valence in all mixed models. The models were successively expanded to include all ECQ subscales and the covariates gender, age, extraversion, and neuroticism. Model comparisons were based on the χ^2 deviance test that tests the difference between the deviances of two nested mixed models. In additional models, we also tested two-way interactions time point and each of the remaining 8 ECQ subscales, as well as three-way interactions between each ECQ subscale, time point, and valence. In Study 3, these analyses were exploratory. To limit the risk of false positive findings, we adjusted the alpha level for these analyses using Bonferroni correction and replicated the analyses in Study 4. Specifically, we tested 8 two-way and 8 three-way interactions, and therefore set the alpha level for these analyses in Study 3 at $\alpha = .05 / 16 = .0031$. Interactions that were significant at this alpha level in Study 3 were re-examined in Study 4 using the conventional alpha level of $\alpha = .05$ for each planned test. Significant interactions were probed by computing the adjusted means for high ($M + 1 SD$) and low ($M - 1 SD$) levels on the ECQ subscale. All variables were standardized on the overall mean and standard deviation prior to the analyses. Mean differences therefore reflect the difference in standard deviation units (Cohen's d). Mixed models were fitted using the lmer function in the R package lmerTest (Kuznetsova, Brockhoff, & Christensen, 2016); interaction effects were tested using the Anova function available in the R package car (Fox & Weisberg, 2011); and

adjusted means were estimated using the `lsmeans` function in the R package `lsmeans` (Lenth & Hervé, 2015).

Finally, we examined the convergence between the ECQ and the DIAMONDS situation characteristics in Study 4 by analyzing the proportion of variance (R^2) that all DIAMONDS together explain in each ECQ subscale.

Results

Item Selection

The results of the different item selection procedures were mostly consistent across the two studies for procedures based on item analysis and item response theory, but more variable for the ant colony optimization approach (Table S4; for item information curves, see Figures S5 and S6). For each subscale except valence, the four items that performed best on the different approaches were selected for the final version of the ECQ. For valence, all six items were retained in order to ensure that positive and negative valence could be measured separately if required. Model fit was acceptable to good for most subscales in both studies (Table 4). One exception was the subscale challenge. For this subscale, a modified model fit the data well in Study 3, but the same model fit the data poorly in Study 4. Despite this discrepancy in model fit, internal consistency was good in both studies.

To examine the overall fit of the ECQ, all measurement models were combined into one confirmatory factor model (for correlations among all ECQ subscales, see Table S10). This model fit the data well in Study 3 but provided an improper solution in Study 4. Specifically, the estimated residual variance of Item 7 of the change in world views subscale was negative. A closer inspection revealed that this item had a very restricted variance in Study 4, with 67 % of participants selecting response option 1. We therefore excluded Item 7 from the overall fit model in both studies. The fit of this model was good, with $\chi^2(521) =$

956.0, $p < .001$, CFI = 0.98, TLI = 0.98, RMSEA = .061, 95 % CI [.055, .068] in Study 3 and $\chi^2(521) = 1064.0$, $p < .001$, CFI = 0.98, TLI = 0.97, RMSEA = .053, 95 % CI [.049, .058] in Study 4. Overall, the psychometric properties of the final ECQ were satisfactory. The complete list of items for the final ECQ is provided in the Appendix.

Table 4. Fit indices and internal consistencies (Cronbach's α) for final CFA models in Studies 3 and 4.

Subscale / Study	Cronbach's α	χ^2	df	p	CFI	TLI	RMSEA
Study 3							
Challenge	.89	2.75	1	.097	1.00	1.00	.09
Emotional significance	.81	3.70	2	.157	1.00	1.00	.06
External control	.85	0.65	1	.420	1.00	1.00	.00
Extraordinariness	.67	0.89	1	.344	1.00	1.00	.00
Impact	.81	8.00	2	.018	0.99	0.98	.12
Predictability	.92	1.32	2	.516	1.00	1.00	.00
Social status change	.87	4.75	2	.093	1.00	1.00	.08
Valence	.97	4.48	2	.106	1.00	1.00	.07
Change in world views	.81	4.49	2	.106	1.00	0.99	.07
Study 4							
Challenge	.88	17.80	1	< .001	1.00	0.98	.21
Emotional significance	.79	1.49	2	.474	1.00	1.00	.00
External control	.86	1.64	1	.200	1.00	1.00	.04
Extraordinariness	.68	2.66	1	.103	1.00	0.98	.07
Impact	.87	2.76	2	.251	1.00	1.00	.03
Predictability	.90	3.51	2	.173	1.00	1.00	.05
Social status change	.88	3.24	2	.198	1.00	1.00	.04
Valence	.94	4.84	2	.089	1.00	1.00	.06
Change in world views	.83	5.29	2	.071	1.00	1.00	.07

Notes. In Study 3, models were modified if necessary to improve model fit. In Study 4, the final models specified in Study 3 were estimated without further modifications. The following modifications were specified: For challenge, residual covariance between Items 40 and 48. For external control, residual covariance between Items 31 and 37. For extraordinariness, residual covariance between Items 8 and 11. No model modifications were specified for emotional significance, impact, predictability, social status changes, valence, and change in world views.

Associations with Retrospectively Assessed SWB Trajectories

Retrospective assessments of SWB were modeled as a function of time point and valence using mixed models. The interaction between time point and valence was statistically significant in both studies (Study 3: $\chi^2(3) = 331.76, p < .001$; Study 4: $\chi^2(3) = 246.81, p < .001$). The average trajectories for positive events and negative events are depicted in Figure 1. These trajectories follow the expected pattern, with SWB levels close to 0 (reflecting normal levels of SWB) before the event, substantial drops (for negative events) or gains (for positive events) at the event, and a return towards the pre-event level over time, which was more pronounced for negative events than for positive events in both studies.

Figure 1. Average trajectories for retrospectively assessed subjective well-being (SWB) for events with high valence (1 *SD* above average valence) and low valence (1 *SD* below average valence) in Studies 3 and 4. Error bars reflect 95% confidence levels.

Adding all ECQ subscales to the model significantly improved the model fit, both with respect to the initial model (Study 3: $\chi^2(8) = 25.72, p = .001$; Study 4: $\chi^2(8) = 33.42, p < .001$), and with respect to a model already including extraversion, neuroticism, age, and

gender as covariates (Study 3: $\chi^2(8) = 27.68, p < .001$; Study 4: $\chi^2(8) = 32.01, p < .001$), indicating that perceived characteristics significantly accounted for individual differences in the *level* of the trajectories. Fixed effects for these models are reported in Table 5. Valence and challenge were negatively and change in world views was positively associated with levels of retrospective SWB in both studies.

To probe whether perceived event characteristics also account for individual differences in the *shape* of the trajectories, we tested interactions between ECQ subscales and time point in separate models (Table 6). Three three-way interactions (subscale $\times$ time point $\times$ valence) that were significant at the conservative significance level of $\alpha = .0031$ in Study 3 (see Methods section) and could be replicated in Study 4 at $\alpha = .05$ were found for impact, predictability, and social status changes (Figures 2 to 4). Adaptation to negative events was slower for individuals who perceived the event as higher in social status change, and adaptation to positive events was slower for individuals who perceived the event as higher in impact and lower in predictability. Note that additional interaction effects were significant at more conventional levels of significance or in only one of the two studies. These effects were not further interpreted due to the exploratory nature of these analyses.

Table 5. Fixed effects regression coefficients for the complete mixed models in Studies 3 and 4.

Predictor	Study 3			Study 4		
	Coefficient	SE	p	Coefficient	SE	p
(Intercept)	-0.11	0.13	.420	-0.02	0.12	.855
Time 2	0.48	0.12	< .001	0.52	0.12	< .001
Time 3	0.67	0.12	< .001	0.55	0.12	< .001
Time 4	0.85	0.12	< .001	0.93	0.12	< .001
Valence	-0.54	0.10	< .001	-0.30	0.10	.002
Timeframe: Within past 6 months				-0.03	0.10	.718
Challenge	-0.14	0.07	.040	-0.24	0.06	< .001
Emotional significance	0.09	0.05	.081	0.13	0.05	.017
External control	0.08	0.05	.088	0.02	0.05	.631
Extraordinariness	-0.06	0.05	.194	-0.01	0.05	.831
Impact	0.00	0.05	.947	0.05	0.06	.458
Predictability	-0.05	0.05	.317	0.00	0.05	.957
Social status changes	-0.10	0.06	.066	0.00	0.05	.949
Changes in world views	0.08	0.06	.171	0.10	0.06	.078
Female	-0.08	0.12	.493	-0.13	0.10	.190
Age	-0.04	0.04	.397	0.04	0.05	.483
Neuroticism	-0.02	0.05	.635	-0.10	0.05	.060
Extraversion	0.18	0.05	< .001	0.02	0.05	.688
Time 2 x Valence	2.15	0.12	< .001	1.72	0.12	< .001
Time 3 x Valence	1.64	0.12	< .001	1.42	0.12	< .001
Time 4 x Valence	1.32	0.12	< .001	0.85	0.12	< .001

Notes. All continuous predictors were standardized on the total sample mean and standard deviation. Regression coefficients for these predictors therefore reflect effects in standard deviation units. Time point was dummy-coded with Time 1 (1 month before the event) as a reference category. Time 2 = at the event, Time 3 = 1 month after the event, Time 4 = today. Female was a dummy variable with 0 = male and 1 = female. In Study 4, timeframe was dummy-coded with "no specified timeframe" as reference category.

Table 6. Results for two-way interactions between perceived event characteristics and time point and three-way interactions between perceived event characteristics, time point, and valence.

Event characteristic	Study 3				Study 4			
	Two-way interaction with time point		Three-way interaction with time point and valence		Two-way interaction with time point		Three-way interaction with time point and valence	
	$\chi^2(3)$	<i>p</i>	$\chi^2(3)$	<i>p</i>	$\chi^2(3)$	<i>p</i>	$\chi^2(3)$	<i>p</i>
Challenge	4.14	.247	9.20	.027	8.36	.039	2.55	.467
Emotional significance	1.54	.674	9.35	.025	3.94	.268	9.19	.027
External control	19.20	< .001*	9.80	.020	5.40	.145	0.39	.943
Extraordinariness	1.46	.691	2.68	.443	2.46	.482	1.75	.626
Impact	13.56	.004	63.84	< .001*	14.97	.002	9.23	.026*
Predictability	2.95	.400	16.46	.001*	1.75	.627	39.55	< .001*
Social status changes	6.12	.106	20.42	< .001*	8.37	.039	11.12	.011*
Change in world views	7.24	.065	14.52	.002*	1.57	.666	4.93	.177

Notes. In Study 3, * marks all $p < .0031$ (Bonferroni-adjusted level of significance at $\alpha = .0031$, see text). In Study 4, * marks only those effects for which $p < .0031$ in Study 3 and $p < .05$ in Study 4 (see text).

Figure 2. Predicted retrospective SWB trajectories in Study 3 (top panels) and Study 4 (bottom panels) as a function of impact (low impact = $M - 1 SD$; high impact = $M + 1 SD$). Error bars reflect 95% confidence intervals.

Figure 3. Predicted retrospective SWB trajectories in Study 3 (top panels) and Study 4 (bottom panels) as a function of predictability (low predictability = $M - 1 SD$; high predictability = $M + 1 SD$). Error bars reflect 95% confidence intervals.

Figure 4. Predicted retrospective SWB trajectories in Study 3 (top panels) and Study 4 (bottom panels) as a function of social status changes (low social status changes = $M - 1 SD$; high social status changes = $M + 1 SD$). Error bars reflect 95% confidence intervals.

Associations with Situation Characteristics

Studies 1 and 2 indicated that some, but not all dimensions of characteristics of MLEs converged with existing dimensions of situation characteristics such as the DIAMONDS. Correlations between the ECQ subscales and the DIAMONDS are provided in Table S11. To

examine to what extent the ECQ subscales converge empirically with the DIAMONDS situation characteristics, we estimated the amount of variance that the DIAMONDS collectively explain in each ECQ subscale. R^2 estimates were very high for challenge ($R^2 = .75$) and valence ($R^2 = .78$), confirming our expectations of high convergence between these ECQ subscales and situation characteristics as measured by the DIAMONDS. Challenge was positively associated with duty, mating, and negativity, and negatively associated with positivity and deception; and valence was positively associated with duty, intellect, and positivity, and negatively associated with negativity and deception, controlling for all other situation characteristics (Table 7). R^2 was also substantial for social status change ($R^2 = .37$), which was positively associated with adversity, mating, and negativity, and negatively associated with sociability. For the remaining ECQ subscales, however, R^2 was .20 or less, indicating that these subscales measure unique characteristics of MLEs that are not fully captured by the DIAMONDS.

Table 7. Standardized regression coefficients and R^2 estimates for ECQ subscales regressed on the 8 DIAMONDS subscales

Predictor	Challenge	Emotional significance	External control	Extraordinaire ss	Impact	Predictability	Social status changes	Valence	Change in world views
Duty	0.14***	-0.13*	0.03	-0.13*	0.11	0.20***	-0.04	0.10**	-0.17**
Intellect	-0.05	0.03	0.07	0.10	0.14*	-0.08	0.01	0.12***	0.19***
Adversity	-0.01	0.00	0.01	0.07	0.02	0.00	0.36***	-0.03	0.07
Mating	0.09**	0.15**	-0.05	-0.16**	0.17**	-0.07	0.12*	-0.05	0.09
Positivity	-0.15***	0.18*	-0.03	0.19*	-0.19*	0.32***	-0.12	0.68***	-0.18*
Negativity	0.76***	0.44***	-0.03	0.23**	0.17*	-0.07	0.17*	-0.22***	0.20**
Deception	-0.07*	0.05	0.34***	0.10	0.00	-0.12	0.08	-0.10**	0.18**
Sociability	0.02	0.11*	0.13*	-0.03	-0.04	0.04	-0.13**	-0.06	0.07
R^2	.75	.19	.14	.07	.18	.20	.37	.78	.29

Notes. *** $p < .001$, ** $p < .01$, * $p < .05$.

Ancillary analyses

We conducted a series of ancillary analyses to probe the robustness of our findings across different design specifications. In Study 4, we had systematically varied the timeframe of the MLE (last week, past 6 months, anytime in the past). In ancillary exploratory analyses, we examined whether the findings reported above differed as a function of the timeframe (for details, see supplemental material). Regarding the mean levels on the ECQ dimensions (see Table S12 for detailed statistics), the three conditions did not differ significantly on predictability, social status changes, and valence. For the other ECQ dimensions, MLEs selected from a broader timeframe tended to be rated as higher in challenge, emotional significance, external control, extraordinariness, impact, and change in world views than MLEs selected from a more restrictive and recent timeframe. In addition, we examined whether the ECQ dimensions were measurement invariant across the three timeframes (for a detailed description of the analytic approach and of the results, see supplemental material). We found evidence for strong measurement invariance (i.e., equal thresholds, factor loadings, and intercepts) for valence, change in world views, social status changes, predictability, impact, external control, and challenge, and evidence for weak measurement invariance (i.e., equal thresholds and factor loadings) for emotional significance. For extraordinariness, the multi-group models did not converge, so we were unable to examine measurement invariance for this subscale. Furthermore, the associations of the ECQ subscales with retrospective SWB trajectories and the DIAMONDS did not differ as a function of the timeframe, with one exception: the association between the ECQ subscale emotional significance and the DIAMONDS dimension Negativity was significantly stronger for MLEs that had occurred within the past 6 months than for MLEs without a specified timeframe (for detailed results, see supplemental material).

In addition, we explored whether the findings differed across different ECQ versions. In an earlier version of this manuscript, we had selected the final items using only the ant colony approach in the Study 3 data. The items selected at this earlier stage were then used in a longitudinal study that had started in summer 2018 (Study 5 in the present manuscript), before Study 4 was conducted. The exact item composition of the final version and the earlier version differ for 7 of the 9 subscales (exceptions: valence, social status change; for details, see Table S3). To examine to what extent the exact item composition of the ECQ subscales affected the results in Studies 3 and 4, we reran these analyses using two alternative ECQ versions: the ECQ version used in Study 5 and a short form of the ECQ that was comprised of only those items that were included in both the final ECQ identified in Studies 3 and 4 and in the ECQ version used in Study 5. The different versions were strongly correlated among each other (all $r_s > .85$ in both Study 3 and Study 4) and did not differ substantively with regard to model fit and internal consistency. Regarding associations with retrospective ratings of SWB, valence and challenge were robustly associated with levels of retrospective SWB across different ECQ versions, but change in world views was not. All three-way interactions were robustly found across different ECQ versions (for detailed results, see Tables S14 and S15).

Summary

In Studies 3 and 4, we combined different analytic approaches to select the final ECQ items. These items provide unidimensional measurements of the nine ECQ subscales with good psychometric properties. The ECQ significantly improved the prediction of the overall level of the retrospective SWB trajectories, and valence, impact, and social status change were significantly and robustly associated with individual differences in the shape of the retrospective SWB trajectories. These findings were robust across two independent and diverse samples and across different timeframes and thus provide initial support for the

predictive utility of the ECQ. A comparison between the ECQ and the DIAMONDS situation characteristics indicated partial overlap between these taxonomies.

A major limitation of both studies was that the cross-sectional and correlational study designs were not suitable to study actual (as opposed to remembered) changes in SWB and other psychological outcomes after MLEs (see General Discussion). In particular, both perceived event characteristics and changes in SWB were assessed retrospectively, which limits our conclusions for several reasons. Assessing perceived event characteristics retrospectively is problematic because these ratings reflect how people perceive the MLE in light of its long-term effects on their life circumstances and their SWB. This might be particular true for consequence-related event characteristics (e.g., change in world views, social status changes). Assessing SWB retrospectively is problematic because people might misremember or misrepresent their past levels of SWB. To minimize these potential recall bias effects, we therefore used a prospective longitudinal design in Study 5.

Study 5: Perceived Event Characteristics as Prospective Predictors of Changes in SWB After MLEs

The goal of Study 5 was to examine whether perceived event characteristics could explain individual differences in actual changes in SWB after MLEs. Based on the results of Studies 3 and 4 as well as previous longitudinal research on changes in SWB after MLEs (Luhmann, Hofmann, et al., 2012), we expected to observe a sudden drop in SWB (reflecting the immediate reaction) and subsequently increasing SWB levels (reflecting adaptation) after negative MLEs, and a sudden gain in SWB and subsequently decreasing SWB levels after positive MLEs. In addition, we analyzed whether other perceived event characteristics could explain individual differences in the SWB trajectories over and above valence and examined to what extent these patterns were consistent with those found for the retrospective data (Studies 3 and 4).

Methods

Study 5 was approved by the local ethics committee of the Ruhr University Bochum (Protocol 422 “Examining characteristics of adverse events as predictors of character growth”).

Sample and Procedure

The data for the present analyses came from the *What’s Next Study*, a 1-year, 5-wave longitudinal study of young adults who had previously graduated from high school or from college. Data collection for this study was implemented in Qualtrics and had started in July 2018 and was completed in October 2019. The study focused on this particular age group because other studies have shown that the year after such a life transition is characterized by a relatively high number of both positive and negative MLEs (e.g., Lüdtke, Roberts, Trautwein, & Nagy, 2011). Young adults interested in participating first registered for the study at a registration website where they provided informed consent and passed the age verification. They could then choose between starting the T1 questionnaire directly or within a week after registration. Invitations for the follow-up questionnaires (T2-T5) were sent out via email 3, 6, 9, and 12 months after T1, respectively. Participants were re-invited to participate at each wave even if they had skipped one wave, unless they withdrew from the study. At each wave, participants were asked to report an MLE that had occurred since the last wave and to complete the ECQ for this MLE. They also completed various self-report measures, including measures of SWB and the Big Five personality traits, which will be used for the present analyses (a detailed description of the study design and a complete list of all self-report measures is provided in the preregistration of the study design at <https://osf.io/kvf5g>). To compensate participants, vouchers for online retailers were raffled at each wave, with the values of the vouchers increasing with each wave to minimize drop-out.

After excluding participants who had provided false or no responses on any instructed response items, the total sample sizes were $N = 706$ at T1, $N = 542$ at T2, $N = 469$ at T3, $N = 425$ at T4, and $N = 411$ at T5. For the present analyses, we focused on the MLE that had been reported at T2 and thus had occurred between T1 and T2. We used data from all waves but restricted the sample to those participants who had participated at both T1 (to ensure that we had prospective data on SWB) and T2 (to ensure that we had ECQ data on the MLE). Furthermore, we excluded participants who, contrary to our instruction (see below), reported an MLE at T2 that had occurred before they had completed the T1 survey ($n = 40$). The total sample sizes for the present analyses were $N = 429$ at T1 and T2 (75.5% female; M_{age} at T1 = 21.7, $SD_{\text{age}} = 4.0$, 78.8 % incoming or continuing college students at T1), $N = 333$ at T3, $N = 294$ at T4, and $N = 285$ at T5, with $N = 235$ completing all 5 waves. To analyze whether the variables investigated for the present paper predicted attrition, we performed a logistic regression analysis with attrition status (0 = skipped at least one wave, 1 = completed all waves) as outcome variable and the ECQ subscales, neuroticism, extraversion, age, and gender as predictors. The only variable that was associated with attrition status was external control, such that participating at all waves was significantly less likely for people who reported MLEs with higher perceived external control, $b = -0.20$, $SE = 0.10$, $p = .043$, 95 % CI [-0.39, -0.01].

Measures

Descriptive statistics and internal consistencies for all measures are reported in Table S16.

Time since event and perceived event characteristics (ECQ). At each wave, participants reported the most significant MLE they had experienced in the last 3 months (at T1) or since the last wave (T2-T5). For the present analyses, we focused on the MLE reported at T2. Participants named the MLE and reported how many weeks had passed since the event.

This information was combined with the exact dates at which participants completed each wave to construct a new continuous time-varying variable that indicated the number of weeks from/to the event for each wave, with 0 reflecting the week of the event.

Because data collection for this study started in August 2018, that is, before Study 4 was conducted and analyzed, perceived event characteristics were measured with the version of the ECQ that had been constructed based on the ant colony optimization approach alone in Study 3 (see above). This ECQ version comprised 37 items that were rated on a 5-point response scale ranging from 1 (*does not apply at all*) to 5 (*applies completely*) (for a complete list of all items, see Table S3). Responses were recoded if appropriate and averaged across items within each subscale to obtain scale scores. To examine to what extent the item composition of the ECQ subscales affected the results, we conducted robustness checks in which we restricted the ECQ subscales to those items that had been retained in the final ECQ version based on results in Studies 3 and 4 (see above). The results for these robustness checks are summarized below and described in detail in the supplemental material.

SWB. Life satisfaction was assessed with the first three items of the Satisfaction With Life Scale (Diener, Emmons, Larsen, & Griffin, 1985; German version by Glaesmer, Grande, Braehler, & Roth, 2011) using a 7-point response scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Mood in the past month was assessed with the 6-item Scale of Positive and Negative Experience (Diener et al., 2010) (German version by Berend & Vogt, 2015) using a 5-point response scale ranging from 1 (*rarely or never*) to 5 (*almost always or always*). In Studies 3 and 4, retrospective measures of life satisfaction and mood were strongly correlated and therefore aggregated to a general SWB score. In Study 5, however, the correlations between life satisfaction and mood were substantially lower, ranging from $r = .62$ to $r = .68$. As frequently recommended in research on MLEs and SWB (Diener, Lucas, & Scollon, 2006; Luhmann, Hawkley, Eid, & Cacioppo, 2012), we therefore examined changes in life satisfaction and mood separately.

Big Five personality traits. The Big Five personality traits were measured with the German version of the 15-item BFI-2 XS (Soto & John, 2017) (German version by Rammstedt et al., 2018). Items were rated on a 5-point scale ranging from 1 (*do not agree at all*) to 5 (*agree completely*). Responses were reversed if appropriate and averaged across items within each subscale. In parallel to Studies 3 and 4, we only analyzed extraversion and neuroticism in Study 5. Following other studies examining extraversion and neuroticism as moderators of changes in SWB after MLEs (Yap et al., 2012), we used only pre-event scores (T1).

Instructed response items. Instructed response items in which participants were requested to select a specific response option for data quality purposes included at each wave (see Studies 3 and 4).

Data analysis

Changes in life satisfaction and mood were modeled with multilevel growth curve models with measurement occasions (Level 1) nested within participants (Level 2). Time was represented in two variables: a dummy variable *pre_dum* that was coded with 1 at T1 and with 0 at all other occasions, and a linear variable *post_lin* that reflected the number of weeks since the MLE. The intercept of the growth curve models therefore reflected the estimated level of the dependent variable at the time of the MLE, the fixed effect for the dummy variable *pre_dum* reflected mean-level differences in the dependent variable between T1 and the time of the MLE, and the fixed effect for the linear variable *post_lin* reflected average linear weekly changes in the dependent variable after the MLE. Both time variables were modeled with fixed slopes, as models with random slopes did not converge. In additional analyses, we examined whether models with quadratic changes after the MLE (additional variable $post_qua = post_lin * post_lin$) improved the model fit; however, this was not the case for either dependent variable.

The modeling strategy mirrored the approach used in Studies 3 and 4. We first estimated a simple model with the two time variables as Level 1-predictors, valence as Level 2 predictor, and the two-way cross-level interactions between each time variable and valence. The models were then successively expanded to include all other ECQ subscales and the covariates gender, age, extraversion, and neuroticism. Model comparisons were based on the χ^2 deviance tests. Finally, we tested three-way interactions between the time variables, valence, and the remaining ECQ subscales, separately for each ECQ subscale, using a significance level of $\alpha = .05$ for each planned test (see Study 4). Significant interactions were probed by computing simple slopes for high ($M + 1SD$) and low ($M - 1SD$) levels on the ECQ subscale.

The dependent variables were standardized on the T1 mean and standard deviation. Hence, changes in these variables could be interpreted in T1 standard deviation units (Cohen's d) (Morris & DeShon, 2002). Continuous Level 2 predictors (ECQ subscales, neuroticism, extraversion, age) were standardized on the grand mean and standard deviation, with one exception: The mean for valence was substantively above the midpoint of the scale ($M = 3.96$, $SD = 1.23$), indicating that most people reported rather positive MLEs. To facilitate interpretability of the simple slopes analyses, we standardized this variable on the midpoint of the response scale (3) and on the T1 standard deviation. The models were fitted using the `lmer` function in the R package `lmerTest` (Kuznetsova et al., 2016); interaction effects were tested using the `Anova` function available in the R package `car` (Fox & Weisberg, 2011); and simple slopes were estimated using the `emtrends` function in the R package `emmeans` (Lenth, 2019).

Results

SWB Trajectories as a Function of Valence

Replicating the effects for retrospective SWB (Studies 3 and 4), changes in both life satisfaction and mood were significantly moderated by the valence of the event (Table 8, Model 1). For both dependent variables, lower levels of valence were associated with a greater drop in SWB from T1 to the time of the MLE (see Figure 5), as indicated by significant negative interactions between the pre-event dummy variable *pre_dum* and valence. Furthermore, the main effect of time since the event (*post_lin*) was positive and the cross-level interaction between time since the event and valence was negative for both dependent variables. This pattern reflects an average upward trend in mood and life satisfaction after the MLE which is stronger for individuals who reported more negative MLEs and weaker for individuals who reported more positive MLEs. These trajectories were robustly found even after controlling for extraversion, neuroticism, age, gender, and the remaining ECQ subscales (Table 8, Model 2).

Figure 5. Predicted trajectories of life satisfaction (left panel) and mood (right panel) in Study 5 as a function of valence. Simple slopes coefficients were computed for high ($3 + 1 SD$) and low ($3 - 1 SD$) levels of valence.

Confidence bands reflect bootstrapped 95% confidence intervals.

Table 8. Fixed effects regression coefficients for multilevel growth curve models in Study 5.

Predictor	Life Satisfaction						Mood					
	Model 1			Model 2			Model 1			Model 2		
	Coef	SE	p	Coef	SE	p	Coef	SE	p	Coef	SE	p
(Intercept)	-0.28	0.07	< .001	-0.03	0.08	.713	-0.42	0.08	< .001	-0.15	0.08	.064
Pre-event dummy (pre_dum)	0.03	0.06	.566	0.03	0.06	.548	0.21	0.08	.006	0.22	0.08	.005
Weeks since event (post_lin)	0.007	0.002	< .001	0.007	0.002	< .001	0.010	0.002	< .001	0.010	0.002	< .001
Valence	0.23	0.04	< .001	0.10	0.05	.038	0.26	0.04	< .001	0.08	0.04	.066
Challenge				-0.06	0.05	.230				-0.16	0.04	< .001
Emotional significance				0.03	0.04	.398				-0.03	0.03	.403
External control				0.0004	0.04	.990				0.07	0.03	.022
Extraordinariness				-0.06	0.04	.114				-0.05	0.03	.119
Impact				0.005	0.04	.912				0.001	0.03	.984
Predictability				0.08	0.04	.064				0.06	0.03	.096
Social status changes				-0.11	0.04	.005				-0.03	0.03	.334
Changes in world views				0.04	0.04	.294				0.02	0.04	.498
Gender: Male				-0.14	0.08	.091				0.004	0.07	.957
Gender: Other				-1.65	0.74	.026				-0.27	0.64	.672
Age				-0.09	0.04	.012				-0.02	0.03	.454
Neuroticism				-0.37	0.04	< .001				-0.45	0.03	< .001
Extraversion				0.13	0.04	< .001				0.14	0.03	< .001
Pre-event dummy (pre_dum) x valence	-0.07	0.03	.018	-0.07	0.03	.015	-0.12	0.04	.003	-0.12	0.04	.002
Weeks since event (post_lin) x valence	-0.002	0.001	.009	-0.002	0.001	.009	-0.004	0.001	.001	-0.004	0.001	< .001

Notes. All continuous predictors were standardized on the total sample mean and standard deviation, except for valence which was standardized on the scale midpoint (3) and the total sample standard deviation. Regression coefficients for standardized predictors reflect effects in standard deviation units. The pre-event dummy variable *pre_dum* was coded with 1 at T1 (the only occasion before the event) and with 0 at all other occasions. Weeks since event (*post_lin*) reflects the number of weeks since the event. Gender was a categorical variable (*female*, *male*, *other*) with *female* as the reference category and the other categories represented in two dummy variables.

SWB Trajectories as a Function of Other Perceived Event Characteristics

Similar to the findings for retrospective SWB, adding all remaining ECQ subscales to the model significantly improved the model fit, both with respect to the initial model, $\chi^2(8) = 23.78, p = .002$, and with respect to a model already including extraversion, neuroticism, age, and gender as covariates, $\chi^2(8) = 17.72, p = .023$). Fixed effects for these models are reported in Table 8 (Model 2). A significant fixed effect indicates that the respective predictor accounts for individual differences in the *level* of the trajectories. Here, the findings differed between life satisfaction and mood. Individual differences in the level of life satisfaction were positively associated with valence and negatively associated with changes in social. Individual differences in the level of mood were negatively associated with challenge and positively associated with external control.

To probe whether perceived event characteristics accounted for individual differences in the *shape* of the trajectories, we tested three-way interactions between valence, each remaining ECQ subscale, and both time variables separately for each ECQ subscale (Tables S17 and S18). For mood, none of these three-way interactions reached our level of significance, indicating that beyond valence, none of the other ECQ subscales predicted individual differences in the shape of the mood trajectories after MLEs. For life satisfaction, there were no significant three-way interactions involving the pre-event dummy variable *pre_dum*; however, the three-way interactions with time since the event (*post_lin*) were statistically significant for challenge ($b = -0.003, SE = 0.001, p = .014$), extraordinariness ($b = -0.002, SE = 0.001, p = .023$), impact ($b = -0.002, SE = 0.001, p = .034$), and social status changes ($b = -0.002, SE = 0.001, p = .005$). Estimated post-event trajectories for high and low levels on these characteristics are depicted in Figures 6 and 7 (for detailed results of these simple slopes analysis, see Table S19). The overall pattern was similar for all four event characteristics: MLEs that were low in valence and high in challenge, extraordinariness,

impact, or social status change were associated with the greatest increase in life satisfaction after the MLE. In contrast, MLEs that were high in valence and/or low in challenge, extraordinariness, impact, and social status change tended to be associated with a less pronounced increase in life satisfaction in the months after the MLE. Hence, negative events that were particularly impactful or memorable (as reflected by high values on the four moderator variables) were characterized by a more pronounced adaptation pattern than positive and more minor events.

Figure 6. Predicted post-event life satisfaction trajectories in Study 5 as a function of valence and challenge (top panel) and as a function of valence and extraordinariness (bottom panel). Simple slopes coefficients were computed for high ($3 + 1\ SD$) and low ($3 - 1\ SD$) levels of valence and for high ($M + 1\ SD$) and low ($M - 1\ SD$) levels on the other ECQ subscale. Confidence bands reflect bootstrapped 95% confidence intervals.

Figure 7. Predicted post-event life satisfaction trajectories in Study 5 as a function of valence and impact (top panel) and as a function of valence and social status changes (bottom panel). Simple slopes coefficients were computed for high ($3 + 1 SD$) and low ($3 - 1 SD$) levels of valence and for high ($M + 1 SD$) and low ($M - 1 SD$) levels on the other ECQ subscale. Confidence bands reflect bootstrapped 95% confidence intervals.

Ancillary analyses

The ECQ version used in Study 5 differed slightly from the final ECQ version identified in Studies 3 and 4. We probed whether the results of Study 5 were robust across different item compositions of the ECQ by rerunning all analyses reported above using a short version of the ECQ that contained only those items that were both included in the final version and assessed in Study 5. For each subscale, the two versions were strongly correlated with all $r_s > .88$. Overall, using the short ECQ version did not substantively change any results, with one exception: The three-way interaction between impact, valence, and time since the event (*post_lin*) was no longer statistically significant when using the reduced scale, suggesting that this effect may have been driven by the item that had to be excluded for the reduced scale. Detailed results for these ancillary analyses are reported in Tables S20 to S22.

Summary

Similar to Studies 3 and 4, perceived valence of the MLE was a robust predictor of individual differences in the level and shape of the SWB trajectories. Experiencing a negative MLE was associated with an immediate drop in both life satisfaction and mood relative to the pre-event level and with a more pronounced increase in both life satisfaction and mood in the subsequent months. Conversely, experiencing a positive MLE was associated with an immediate gain in both life satisfaction and mood relative to T1 and with a less pronounced increase in both life satisfaction and mood. Note that in this sample, there was a general upward trend in both life satisfaction and mood across the entire study period, so any changes in these variables in the post-event months need to be interpreted relative to this general trend. Overall, these findings are consistent with those found for retrospective SWB in Studies 3 and 4 and also with previous research in the SWB literature on reaction and adaptation to MLEs (Luhmann, Hofmann, et al., 2012).

The two-way interaction between valence and time since the event (*post_lin*) was further significantly moderated by challenge, extraordinariness, impact, and social status change. The general pattern was similar across these four variables: Post-event increases in life satisfaction were particularly pronounced among participants who reported MLEs that were perceived as negative and particularly significant in terms of challenge, extraordinariness, impact, or social status change. These findings indicate that measuring perceived event characteristics beyond valence might be particularly valuable in order to explain changes in life satisfaction after negative MLEs. However, these three-way interactions diverged from those found in Studies 3 and 4. Challenge and extraordinariness had not significantly and robustly been associated with the shape of the retrospective trajectories. Furthermore, in contrast to Studies 3 and 4, we did not detect a significant interaction for predictability in Study 5. Finally, the effects for impact and social status changes were in the opposite direction. In the retrospective data, these variables had been associated with less pronounced changes, whereas in the longitudinal data, these variables were associated with more pronounced changes. We discuss possible explanations for these divergent findings in the General Discussion.

Except for valence, perceived event characteristics did not significantly explain any individual differences in the shape of the post-event mood trajectories. Previous research has often reported weaker effects of MLEs and life circumstances on mood than on life satisfaction (Hentschel, Eid, & Kutscher, 2017; Luhmann, Hofmann, et al., 2012; Schimmack, Schupp, & Wagner, 2008), which might explain why perceived event characteristics were mostly unrelated to changes in mood in this study. This finding underscores the importance of investigating mood and life satisfaction separately in studies on MLEs (Diener et al., 2006).

General Discussion

MLEs differ in their impact on psychological outcomes, with some having positive effects, others negative effects, some transient, others lasting. In this paper, we proposed a dimensional taxonomy of event characteristics that allows researchers to distinguish MLEs systematically and to investigate which characteristics are relevant to predict the direction, strength, and duration of the effect of an MLE on psychological outcomes. Our taxonomy comprises nine distinct characteristics of MLEs that can be measured with the Event Characteristics Questionnaire (ECQ). Together, these perceived event characteristics could explain individual differences in retrospective and longitudinal changes in SWB over and above person characteristics such as personality and demographics, indicating that considering perceived event characteristics may improve the prediction of people's reaction and adaptation to MLEs. In this final section, we discuss the structure and content of the ECQ, the utility of perceived event characteristics as predictors of changes in psychological outcomes, the relationship between event characteristics and situation characteristics, and limitations and directions for future research.

Structure and Content of the ECQ

Of the 9 characteristics, 5 refer to the event itself (valence, challenge, predictability, external control, extraordinariness) and 4 refer to the perceived consequences of the event (impact, emotional significance, change in world views, change in social status). As discussed in the situation literature, characteristics of a situation should be assessed separately from the consequences of a situation (e.g., Rauthmann, 2015). Applied to the ECQ, this means that the five event-focused characteristics provide a conceptually cleaner description of the MLE than the four consequence-focused characteristics. How did the consequence-focused characteristics end up in the ECQ, and should we keep them? The inclusion of consequence-focused event characteristics is a direct effect of partly basing our item development process

on taxonomies of event characteristics that had been discussed in the existing literature. Most previous taxonomies included at least one dimension referring to adjustment and change or to emotional significance and stress associated with the event (Table 1), indicating that these types of event characteristics were deemed of theoretical and/or empirical importance in previous work to explain long-term psychological outcomes. Consistent with this view, those ECQ dimensions that most robustly explained individual differences in both retrospective and longitudinal SWB trajectories (beyond valence) were consequence-focused event characteristics (impact and social status change). Hence, consequence-focused event characteristics might be particularly relevant to predict long-term changes in psychological outcomes after MLEs, whereas event-focused characteristics might be more relevant to explain short-term changes in these outcomes immediately after the MLE. Thus, including both consequence-focused and event-focused characteristics might improve the predictive utility of the ECQ.

However, the inclusion of consequence-focused characteristics also introduces an important conceptual problem. We know from the situation literature that evaluating a situation based on its consequences is problematic because it introduces circularity (consequences corollary; Rauthmann, 2015): The direct consequences of an MLE (e.g., impact, social status change) are used to predict its long-term psychological consequences (e.g., changes in SWB). The circularity problem is particularly salient in studies where perceived event characteristics and psychological outcomes are rated at the same point in time by the same rater. A partial solution is to separate these ratings in time, for example by assessing perceived event characteristics early after the MLE and psychological consequences repeatedly later on, as we did in Study 5. In addition, future studies should obtain ratings of perceived event characteristics and psychological outcomes from multiple sources. For example, informant ratings could be used for the event characteristics (Rauthmann et al., 2015) and/or for the psychological outcome. Future research therefore needs to determine

whether the ECQ can be used by informants (who may or may not know the person having experienced the event) who rate events that occurred to other people (who may be real or hypothetical).

Perceived Event Characteristics and Changes in Psychological Outcomes

MLEs are of interest not only in research on SWB, but also in other research fields such as personality development (Bleidorn et al., 2018), posttraumatic growth (Jayawickreme & Blackie, 2014), health psychology (Cohen et al., 2019), or clinical psychology (Keyes et al., 2011; Monroe & Reid, 2009). A common finding across these different psychological research fields is that findings generalizable across different events and individuals are rare because the effects of MLEs on psychological outcomes differ both among MLEs and among individuals. Previous attempts to explain differences among MLEs have typically distinguished MLEs in rather simple ways, such as describing MLEs as positive or negative events or by assigning them to different life domains (e.g., Bleidorn et al., 2018; Cohen et al., 2019). While such simple classifications do account for some variation among MLEs, most of the variation remains unexplained. Previous attempts to explain differences among individuals typically focused on person characteristics such as age, gender, or specific personality traits, and the results were often inconsistent across studies.

In sum, in most research fields that study MLEs, the question of why the effects of MLEs differ among both events and people is still unresolved. We propose that perceived event characteristics may account for at least some of these differences. In the present studies, we were not yet able to investigate whether event characteristics accounted for systematic differences among MLEs because the number of specific MLEs was not yet sufficient for these kinds of analyses. We were, however, able to provide some initial evidence on the utility of event characteristics to explain differences among individuals.

Perceived Event Characteristics and Individual Differences in SWB Trajectories.

Perceived event characteristics were significantly associated with individual differences in both retrospective and prospective SWB trajectories in our studies. The most robust predictor across studies was the perceived valence of the MLE. Two additional event characteristics that were consistently associated with individual differences in the SWB trajectories were social status changes and impact, both consequence-focused characteristics that reflect to what extent people's life circumstances have changed in the aftermath of the event. For many psychological outcomes, the exact mechanisms through which MLEs affect these outcomes are still unclear. For example, for SWB, different theories highlight different mechanisms, ranging from automatic, homeostatic processes to cognitive processes such as social or temporal comparisons (for an overview, see Luhmann & Intelisano, 2018). One recent theory, the Hedonic Adaptation Prevention Model (Sheldon et al., 2013), proposes that MLEs trigger more minor events which in turn affect SWB. From the perspective of this theory, our findings on social status changes and impact suggest that those minor events that to are related to how people are perceived by others and how much their everyday life changed may be particularly relevant for changes in SWB. In sum, these findings illustrate how considering consequence-related characteristics may shed some light onto the underlying mechanisms through which MLEs lead to changes in psychological outcomes.

For other event characteristics, the associations with individual differences in SWB trajectories were less robust. This is particularly interesting for characteristics that were frequently mentioned in the literature (see Table 1) such as controllability and attribution (external control in the ECQ). However, we should not prematurely conclude that these perceived event characteristics have no predictive utility based on the data in this study alone. Recall that we sampled a broad range of different MLEs to ensure that the ECQ can be applied to many different MLEs. However, this approach has the important limitation that we cannot study specific MLEs in more detail. It is possible that some event characteristics are

important predictors of psychological changes for specific MLEs. For example, one study on changes in life satisfaction after bereavement found that adaptation was quicker among people with strong beliefs in external locus of control than for people with weak beliefs in external locus of control (Specht, Egloff, & Schmukle, 2011). We would therefore expect that the ECQ dimension external control predicts changes in life satisfaction after bereavement, even if it does not predict changes in life satisfaction after other MLEs. One important avenue for future research on event characteristics is to conduct studies that target specific MLEs.

The predictive utility of perceived event characteristics may also depend on the psychological outcome. For example, according to posttraumatic growth theories (e.g., Jayawickreme & Blackie, 2014; Park, 2010), highly adverse MLEs can shatter people's world views and require them to make meaning of the MLE in a way that can result in positive changes in character strengths such as prosocialness or empathy (e.g., Lim & DeSteno, 2016). However, more recent research indicates that such positive personality change may also occur after positive MLEs (Mangelsdorf et al., 2019). Measuring event-related characteristics such as perceived valence and consequence-related characteristics such as changes in world views may help resolve this question and simultaneously shed light onto the mechanisms underlying posttraumatic growth. Finally, there are many other possible moderators of the predictive utility of event characteristics, including other event characteristics and person characteristics (i.e., event $\times$ person interactions). These complex possibilities cannot be addressed in a handful of studies but require a cumulative research effort.

Retrospective vs. Prospective Assessments and Recommendations for Future Studies. How should future studies on perceived event characteristics and changes in psychological outcomes be designed? As widely acknowledged in most fields that study MLEs, such studies should use a longitudinal design in which the outcome variable is measured repeatedly after the MLE and, ideally, also before the MLE (Cohen et al., 2019; Jayawickreme & Blackie, 2014; Luhmann et al., 2014). In studies that also incorporate

measures of perceived event characteristics, researchers additionally need to consider when to measure these event characteristics. Measuring perceived event characteristics as early as possible after the MLE, as we did in Study 5, has the advantage that recall biases are minimal and ratings of the characteristics of the MLEs are not yet entangled with their longer-term consequences.

This phenomenon may in fact be one explanation for why the findings for impact and social status changes differed between the retrospective data (Studies 3 and 4) and the prospective longitudinal data (Study 5). In Studies 3 and 4, where event characteristics and SWB were both assessed retrospectively, people who reported MLEs that were negative and high in perceived social status change reported slower increases in remembered SWB, and people who reported MLEs that were positive and high in perceived impact reported slower decreases in remembered SWB. Hence, in both cases, the effects of the MLEs were still felt in the present. These results are plausible, but they do not necessarily reflect how people perceived the event at the time it occurred nor how their SWB actually changed since the event. Instead, these patterns could also be due to a tendency of people to view their past selves in a way that is favorable for their present selves (Ross & Wilson, 2003). In this case, there are two potential sources for bias. First, people who have experienced a permanent (positive or negative) change in SWB might be more likely to attribute these changes to the MLE they reported and therefore exaggerate the consequence-related characteristics of this event. That is, the event might be perceived differently in hindsight than at the time it occurred because people tend to re-evaluate the impact and meaning of MLEs as temporal distance to the event increases (Park, 2010; Wilson & Gilbert, 2008). One task for future research on event characteristics is therefore to examine how perceptions of event characteristics change over time. Second, and vice versa, people who reported an MLE that they perceived as particularly strong in terms of impact or social status change might underestimate how much they already adapted to the event and therefore be more likely to

report SWB trajectories that are characterized by slower adaptation and more permanent changes. The tendency to underestimate one's capability to adapt to MLEs has been established for events in the future (affective forecasting; Wilson & Gilbert, 2005). Something similar might also occur if people remember their adaptation to events in the past ("affective backcasting"; for prior usage of this term, see Ebert, Gilbert, & Wilson, 2009).

The longitudinal data in Study 5 suggest that some of these possible biases might have affected the results in Studies 3 and 4. Here, higher perceived impact and social status changes were associated with greater increases in life satisfaction after negative MLEs, suggesting that (a) only negative, important MLEs require people to adapt in the first place and (b) that adaptation is indeed the predominant outcome for people having experienced an impactful negative MLE. This finding is not only consistent with adaptation theories discussed in the SWB literature (e.g., Cummins, 2014; Headey & Wearing, 1992; Lykken & Tellegen, 1996), but also with theories on posttraumatic growth that posit that highly adverse events are often followed by positive psychological changes (Tedeschi & Calhoun, 2004).

In sum, these findings highlight the importance of choosing the appropriate research design wisely. If one is interested in how people perceive their past, retrospective data might be a pragmatic approach. However, most researchers who study MLEs are interested in actual changes in psychological outcomes, which can only be studied adequately with prospective longitudinal designs.

Perceived Event Characteristics and Situation Characteristics

In the past years, multiple taxonomies of situation characteristics have been proposed and are now widely used in psychological research (Rauthmann & Sherman, 2018). The present taxonomy of event characteristics was developed independently of these taxonomies of situation characteristics. Throughout the paper, we highlighted conceptual and empirical similarities and differences between these two approaches. Conceptually, situations and MLE

can be viewed as overlapping but distinct concepts. Similarly, there was conceptual and empirical overlap between some but not all characteristics used to describe situations and MLEs. Style characteristics such as valence or challenge appeared in both approaches and were strongly correlated in the empirical study. Other characteristics, however, were unique to one of the two approaches. For example, situation taxonomies did not include consequence-focused characteristics such as social status change or change in world views. This makes them conceptually purer than the ECQ because characteristics of the situation itself are not confounded with the impact of situation. However, the omission of consequence-focused characteristics may also limit the predictive validity of existing situation taxonomies in predicting long-term outcomes of MLE (see previous section). Conversely, content characteristics of situations such as duty or sociability show little convergence with any of the ECQ subscales.

The literature on situation characteristics is also informative in other ways. Many fundamental conceptual problems that arise when studying characteristics of MLE exist in the situation literature as well (Rauthmann et al., 2015). Future theory building and empirical studies on characteristics of MLEs will benefit from using the situation literature as a guidance towards the conceptual problems and its solutions. Conversely, research on situation characteristics may benefit from insights from research on characteristics of MLEs, which the ECQ facilitates. For example, the ECQ includes a broader range of style characteristics than prominent taxonomies of situation characteristics (Rauthmann, 2015), and situation research might benefit from including additional style characteristics into their taxonomies as well.

Limitations and Future Research

The present paper is a first step towards establishing a broad research program aimed at understanding the role of perceived event characteristics. In the previous sections, we outlined a number of research questions and methodological challenges associated with the

studies presented here that should be addressed in future research. In addition to the issues discussed above, two further limitations should be considered.

A first limitation is that we did not use the same ECQ version in all studies. This was due to practical reasons, as the final ECQ scale was only identified after data collection for the longitudinal study (Study 5) had started. Ancillary analyses showed that the substantive conclusions differed minimally across different ECQ versions. Nonetheless, this issue leaves researchers interested in implementing the ECQ in their own research with the question which scale they should use. We suggest using the final ECQ version because it is the one with the best psychometric properties. If the total number of items is a concern, researchers may also use short forms of the ECQ that comprise only 1 or 2 items per dimension (Luhmann, Fassbender, & Krasko, 2020).

A second limitation is that the ECQ has so far only been used to rate MLEs that participants reported voluntarily. We chose this approach to retrieve a great variety of different MLEs and thereby maximize the observed variance on the perceived event characteristics. However, this approach also comes with limitations. First, it was not possible to examine specific MLEs in more detail. Studies applying the ECQ to specific MLEs are desirable in order to estimate the extent to which people differ in their perceptions of events that were traditionally treated as objectively identical and in order to examine whether all ECQ subscales are relevant to describe characteristics of specific events. As more data on how people perceive different types of events become available, it will also be possible to identify typical profiles of specific events and to separate consensual ratings (i.e., the extent to which people experiencing or observing the same MLE agree on its characteristics) and idiosyncratic perspective (i.e., the extent to which individual ratings differ from the typical ratings) (see Rauthmann et al., 2015). Second, our non-representative Western samples might differ from other populations with respect to which MLEs they experience, which MLEs they choose to report, and how they perceive the characteristics of this MLE. For example,

participants tended to report more positive than negative events (as indicated by average valence ratings that were above the midpoint of the scale) in all studies reported in this paper. However, the findings in Study 5 suggested that perceived event characteristics appeared to be particularly relevant to explain individual differences in actual changes in life satisfaction after negative events, and less so after positive events. To better understand under which circumstances perceived event characteristics matter, future studies should therefore oversample events or even focus on specific events that are perceived as negative. This approach might be a promising avenue for future studies on SWB as well as for studies focusing on other psychological outcomes because previous research indicates that negative events are particularly likely to trigger personality development and growth (Mangelsdorf et al., 2019). More generally, future research on event characteristics should attempt to recruit more heterogeneous (ideally representative) samples in different cultures. As a next step in this research program, the ECQ will be translated to other languages to allow studying characteristics of MLEs in different cultures.

Conclusion

MLEs are studied in a large number of research fields. We propose that considering event characteristics in MLEs may advance the understanding of why, when and for whom MLEs are associated with psychological outcomes in all of these research fields. Such an improved understanding is not just of theoretical interest, but may also eventually have practical implications. In the long run, characteristics of MLEs may be useful to prospectively predict for whom recovery from adverse events is slow, or for whom adaptation to positive events is very quick, and thereby inform decisions on how to allocate support resources to people experiencing MLEs. The taxonomy introduced in this paper is a first step in this direction.

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Appendix

Appendix A. Final ECQ items

Original (German) items	Translated (English) items
Challenge	
1. Das Ereignis hat mir Angst gemacht.	1. The event scared me.
2. Das Ereignis hat mich erschöpft.	2. The event exhausted me.
3. Das Ereignis war stressing.	3. The event was stressful.
4. Das Ereignis war anstrengend.	4. The event was exhausting.
Emotional significance	
5. Das Ereignis hat mich sehr bewegt.	5. The event moved me a lot.
6. Das Ereignis hat starke Gefühle ausgelöst.	6. The event elicited strong feelings.
7. Ich erinnere mich häufig an das Ereignis.	7. I remember the event frequently.
8. Das Ereignis war emotional bedeutsam für mich.	8. The event was emotionally significant to me.
External control	
9. Das Ereignis wurde durch andere Menschen verursacht.	9. The event was caused by other people.
10. Andere tragen Verantwortung für das Ereignis.	10. Others were responsible for the event.
11. Das Ereignis lag in der Hand anderer Menschen.	11. The event was in the hands of other people.
12. Andere hatten einen hohen Einfluss auf das Ereignis.	12. Others had a strong influence on the event.
Extraordinariness	
13. Andere Menschen, die mir ähnlich sind, erleben dieses oder ähnliche Ereignisse auch. (-)	13. People similar to me also experience this or similar events. (-)
14. Das Ereignis erleben die meisten Menschen wie ich in ihrem Leben. (-)	14. Most people like me experience this event sometime in their lives.
15. Das Ereignis erleben nur wenige Menschen wie ich in ihrem Leben.	15. It is uncommon for people like me to experience such an event in their lives.
16. Das Ereignis war außergewöhnlich.	16. The event was extraordinary.
Impact	
17. Das Ereignis hat zu Veränderung in meinen sozialen, familiären oder beruflichen Rollen geführt.	17. The event led to changes in my social, family, or work roles.
18. In Folge des Ereignisses musste ich mein Leben verändern.	18. I had to change my life because of the event.
19. Das Ereignis hatte einen starken Einfluss auf mein Leben.	19. The event had a strong impact on my life.
20. Das Ereignis hatte viele Auswirkungen auf meinen Alltag.	20. The event had multiple effects on my daily life.

<hr/> Predictability	
21. Das Ereignis trat unerwartet ein. (-)	21. The event occurred unexpectedly. (-)
22. Ich wusste schon vorher, dass das Ereignis eintreten würde.	22. I knew in advance that the event would be happening.
23. Das Ereignis trat plötzlich ein. (-)	23. The event occurred suddenly. (-)
24. Das Ereignis war überraschend. (-)	24. The event was surprising. (-)
<hr/> Social status change	
25. Das Ereignis hat meinen sozialen Status bedroht.	25. The event threatened my social status.
26. Das Ereignis hat mir sozial geschadet.	26. The event hurt my social standing.
27. Das Ereignis hat meinen gesellschaftlichen Status verschlechtert.	27. The event impaired my social status.
28. Mein Ansehen hat unter dem Ereignis gelitten.	28. My reputation suffered from the event.
<hr/> Valence	
29. Das Ereignis war positiv.	29. The event was positive.
30. Das Ereignis war negativ. (-)	30. The event was negative. (-)
31. Das Ereignis war freudig.	31. The event was joyful.
32. Das Ereignis war ein Verlust. (-)	32. The event was a loss. (-)
33. Das Ereignis war traurig. (-)	33. The event was sad. (-)
34. Das Ereignis war ein Gewinn.	34. The event was beneficial.
<hr/> Change in world views	
35. Das Ereignis hat dazu geführt, dass ich Dinge aus einer anderen Perspektive betrachte.	35. The event let me view things from a different perspective.
36. Das Ereignis hat meine Ansichten verändert.	36. The event changed my world views.
37. Das Ereignis hat meine Einstellungen verändert.	37. The event changed my attitudes.
38. Durch das Ereignis sehe ich die Welt mit anderen Augen.	38. I see things differently because of the event

Notes. Items were translated for the purpose of data presentation only and have not yet been validated

empirically. The German response format ranged from 1 (*trifft überhaupt nicht zu*) to 5 (*trifft voll und ganz zu*).

Items marked by (-) need to be reversed for scoring.