A systematic review and natural language processing-based integration of the structure of core beliefs across fields

Abstract

Core beliefs are central variables for explaining, predicting, and modifying both clinical disorders and non-clinical experiences and behavior. Structural models of core beliefs define these core beliefs and explicating their number and relations. To date, the literature on the structure of core beliefs is scattered and disconnected, with approaches differing in scope and objective. In a systematic review, approaches across different fields are sighted. Published structural models of core beliefs as well as their operationalizations were included in the review. Additionally, in a substantive-methodological synergy using natural language processing and network models, previously proposed core beliefs are summarized in a hierarchical structural model, the CorBel model. According to a review of 1043 publications, 46 unique sources were revealed, proposing a total of 248 core beliefs. From these sources, 756 items could be obtained that were aggregated on different hierarchical levels, including nuances, facets, and high-bandwidth dimensions of domain and valence. The present research provides an integration of the scattered literature. The integrative CorBel model allows for a comprehensive, fine-grained analysis of individual core beliefs and a systematic analyses of core beliefs in research and applied settings such as counselling or health prevention.

Public significance statements

This review provides a systematic review on core beliefs proposed in the literature. Core beliefs are stable cognitions that reflect what individuals think about themselves. Existing core beliefs are analyzed via natural language processing and integrated in the CorBel model, a network-based structural model of core beliefs.

Keywords

Review; core belief; cognitive therapy; natural language processing; network model

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Core beliefs are basic, generalized, and relatively stable cognitions that reflect what individuals think about themselves within their social and cultural context (Beck, 1970; Dweck, 2017; Young, 1999). These beliefs emerge as cognitive representations of experiences that individuals have while interacting with their environment and are used in interpreting new information, setting new goals, and choosing behavioral strategies for pursuing these goals. For example, maladaptive core beliefs are a precursor for a range of psychological disorders, including depression (Bishop et al., 2022), and modifying maladaptive beliefs is a cornerstone in cognitive and schema therapy (Gladstone & Parker, 2001).

To date, the domain of core beliefs is scattered and disconnected (Pilkington et al., 2022). Existing conceptualizations were developed independently in different subdisciplines and differ in scope, number of proposed beliefs, assumed latent structure, and operationalization. An overarching structural model of core beliefs, comparable to that for psychological traits (Goldberg, 1990), does not exist. Such a model would provide a common language as a basis for systematic research, for integrating findings across domains, for systematically investigating relations to needs, experience, goals, personality traits, and psychological disorders, and as a theoretical backdrop for a comprehensive profile of individual core beliefs for counseling, selection, or therapy. This manuscript provides a systematic review of existing models on the structure of core beliefs proposed in diverse areas. Additionally, a substantive-methodological synergy aims at comprehensively synthesizing these core beliefs in an eclectic, network-based model.

Approaches to core beliefs across fields

Core beliefs have been proposed and investigated in different fields. The largest literature on core beliefs emerged from clinical psychology, initiated by the cognitive framework of Aaron Beck (1976). He assumed that negative basic beliefs underlie the development and maintenance of emotional disorders. Further developments to the cognitive framework include schema theory by Jeffrey Young (2003) and rational-emotive therapy by Albert Ellis (1993). According to these approaches, many attempts have been made to identify core beliefs which , either in general or for specific disorders (Weissman & Beck, 1978). One of the widely used models was developed by Young (1999) who proposed 18 core beliefs (e.g., emotional deprivation; abandonment). Other approaches proposed single or multiple core beliefs relating to specific disorders such as social anxiety (e.g., excessively high standards for social performance; Wong & Moulds, 2011) or posttraumatic beliefs (e.g., threat of harm, Vogt et al., 2012).

According to the clinical focus, these approaches focused only on maladaptive beliefs, ignoring adaptive or positive beliefs. This circumstance changed only very recently with attempts to identify positive or adaptive core beliefs (Louis et al., 2018). Steffen et al. (2017) considered moderate, adaptive core beliefs on an intermediate level (e.g., reasonable standards) between bipolar opposites consisting of overly negative (e.g., lack of standards) versus excessively positive (e.g., excessive standards). Louis et al. (2018) proposed moderate, adaptive core beliefs as counterparts to the negative schemas proposed by Young (1999), e.g., emotional deprivation vs. emotional fulfillment.

Independently of these approaches, core beliefs have been proposed in personality psychology as important variables of personality structure, processes and development (Baumert et al., 2017; Bleidorn, 2009; Corr & McNaughton, 2013; DeYoung, 2015; Dweck, 2017; Fleeson & Jayawickreme, 2015; McAdams & Pals, 2006; Mischel, 1973; Read et al., 2010; Roberts,

2009). For example, Dweck noted that "a major tenet of the current theory is that beliefs are a key part of motivation, personality, and development, much more so than has generally been appreciated" (Dweck, 2017, p. 698). Others have referred to core beliefs as schemas (Roberts, 2009), knowledge about the world and the self (DeYoung, 2015), self-images (McAdams & Pals, 2006), self-reflections (Baumert et al., 2017), or personal constructs and units for self-description (Mischel, 1973). Beliefs considered in the social-cognitive framework include self-efficacy beliefs (Bandura, 1997), locus of control (Rotter, 1966), and self-esteem (Coopersmith, 1967). The belief of control was also considered in attribution theory (Heider, 1958; Kelly, 1955; Weiner, 1985). Dweck proposed the two dimensions of goodness and control as two pervasive and powerful classes of beliefs (Dweck, 2017). The belief of goodness refers to basic judgments people make according to valence, that is representations of the self, others or the world as good/ bad or just/unjust (Janoff-Bulman, 1989; Zajonc, 1980).

Finally, other approaches have considered core beliefs in the context of self-concept (Shavelson et al., 1976), attachment (Ainsworth et al., 1978; Bowlby, 2005), development and learning (Marsh et al., 1985), well-being and resilience (Noad, 2002), organizational behavior (Judge et al., 2002), political psychology (Duckitt et al., 2002), and personality traits (Langston & Sykes, 1997).

Thus, depending on the field in which they were investigated and the scope and goal of the respective research, models on core beliefs differ largely in objective, content, detailedness and assumed latent structure (Pilkington et al., 2022). Currently, practitioners and researchers interested in assessing and investigating core beliefs have to make a choice for any of these models, thereby necessarily neglecting part of the construct domain that was not covered by the respective model. Thus, a comprehensive assessment and investigation of individual core beliefs

is difficult to obtain. In the present manuscript, existing approaches on the structure of core beliefs are revealed in a systematic review. The review is oriented along the following research question:

Research questions 1: Which core beliefs have been proposed in the literature?

A network-based approach using natural language processing

Structural models (e.g., Ashton et al., 2014; Carroll, 1993; Costa & McCrae, 1988; DeYoung et al., 2007; Goldberg, 1990) represent milestones in personality psychology as they provide a framework for assessing and investigating personality constructs and a common language to integrate findings across scientists and disciplines. Traditionally, these models and are based on factor-analytic studies based on empirical co-variation between a feasible number of items representing the personality domain to be explained.

There are at least two challenges within this approach related to collecting and analyzing the underlying data. The first challenge relates to the ubiquitous use of factor analysis. Particularly, the interpretation of factors and selection of indicator variables in exploratory factor analysis follows the principle of simple structure which is satisfied if variables show high factor loadings on one factor and low factor loadings on all other (McDonald, 1985). Likewise, in confirmatory factor analysis, all variables are assumed to have zero factor loadings on all factors other than the one they are designed to measure (Jöreskog & Sörbom, 1979). Thus, there are no cross-loadings, also referred to as variable complexity of one (Asparouhov & Muthen, 2009). Additionally, in reflective models, latent factors are assumed to cause variation in observed behavior, and the latter can be used as manifest indicators of latent factors. These assumptions have been found to be overly strict; accordingly, items with cross-loadings on multiple factors either had to be removed (despite being potentially important), or were retained but caused correlations between otherwise independent factors (e.g., DeYoung et al., 2007).

Network models are an alternative representation of the latent structure of a domain that are increasingly used in different areas (Borsboom et al., 2021; Cramer et al., 2012; Fried & Cramer, 2017). Examples include semantic networks (in which concepts are connected through shared meanings), social networks (in which people are connected through acquaintance) and neural networks (in which neurons are connected through axons; Borsboom et al., 2021). They can be used to explore the structure of high-dimensional data in the absence of strong prior theory. Psychological networks consist of nodes representing observed variables, connected by edges representing statistical relationships. Within this view, personality is conceptualized as inter-connected components (Cramer et al., 2012). Personality dimensions emerge as clusters as a result of co-variation between components.

The second challenge relates to the sheer number of items on which data has to be collected. As structural models of personality usually aim at describing variation in the full spectrum of a certain domain, the number of items to be analyzed and integrated on different hierarchical levels is often huge. For example, in the early days of research on personality structure, Gordon Allport extracted 18.000 words from the Webster's New International Dictionary (Harris & Allen, 1925) describing behavior that distinguished one individual from another – a situation which he referred to as "a semantic nightmare" (Allport, 1937). As collecting data on such many items is not feasible, Allport relied on judges to identify synonyms and to categorize words. However, such ratings are prone to distortion due to idiosyncratic tendencies and errors. As such, Allport and Odbert (1936) reported that the agreement of three editors averaged to only 47 per cent of the terms (Allport & Odbert, 1936).

In the present study, a novel approach is applied that builds upon the latest methods of artificial intelligence and natural language processing which allows for simultaneously analyzing

a virtually unlimited number of items. The term *natural language processing* refers to the processing of natural language with the aid of a computer (Collobert et al., 2011). The meaning of a word or phrase is represented in the form of a vector, also called word embedding. These embeddings are used by computers to understand, interpret, and manipulate human language. A milestone in estimating these embeddings was the development of the word2vec algorithm (Mikolov et al., 2013) which estimates the embeddings from the context in which a word is presented. Using neural networks, large amounts of text (e.g., derived from books, the internet, or social media) are analyzed such that similarities between vectors represent similarities in semantic content. Since then, these models have been continuously developed to provide more accurate embeddings and increase computational efficacy (Devlin et al., 2018; He et al.). For example, the Sentence-BERT (Bidirectional Encoder Representations from Transformers) uses siamese and triplet network structures which reduces computational time for finding the two most similar sentences in a data base from 65 hours (using deBERTa; He et al.) to 5 seconds (Reimers & Gurevych, 2019a). Today, natural language processing approaches are used in many everyday life applications such as translation programs, autocorrect functions, dialogue systems, part-of-speech tagging, search for plagiarism, text classification, text extraction, or text generation (Young et al., 2018). Also, there are first applications in psychology, including generation of items for psychological tests (Götz et al., 2022); automatic analysis of free text responses (Gratz et al., 2022); or producing variance-covariance matrices for personality adjectives (Cutler & Condon, 2023).

In the present study, a novel natural language analysis approach was chosen to investigate the structure of core beliefs. This approach is in line with the heart of the sedimental hypothesis assuming that personality structure can be inferred from a lexical analysis of trait language. Therefore, for core beliefs identified according to research question 1, embeddings were

estimated using a sentence-transformers. Cosine similarity between embeddings reflects semantic similarity between core beliefs and was estimated to construct a variance-covariance matrix which was further analyzed using network models and cluster analyses to identify unique (compared to redundant) core beliefs and to investigate the latent structure of core beliefs according to similarities in embeddings. In line with structural models of personality, a hierarchical structure may be assumed with broader domains on higher levels of the hierarchy and narrow facets and nuances on lower levels. Thus, analyses are aligned towards answering the following research question:

Research Question 2: How can the latent structure of core beliefs be described on different hierarchical levels?

The present study

This manuscript describes a substantive-methodological synergy toward the integration of the scattered field on existing approaches of the structure of core beliefs. In a first step, a systematic literature review was performed to identify core beliefs previously proposed across different areas. In a second step, a natural language-based analysis was conducted of core beliefs proposed in these approaches. Results are integrated in a model that provides a comprehensive description of the structure of core beliefs and allows for a systematic investigation of the processes underlying individual differences and personality development.

Methods

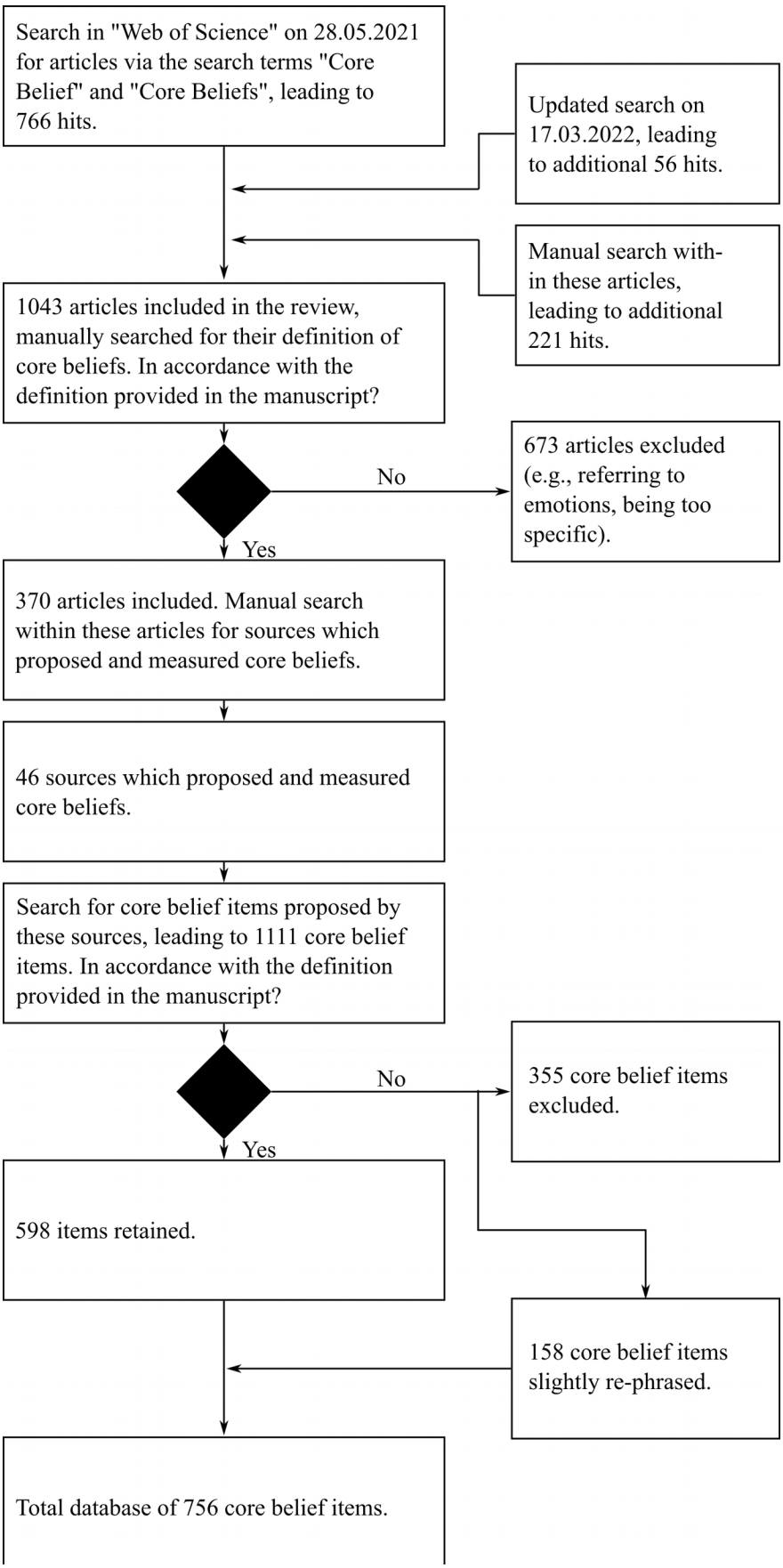
Systematic review.

A comprehensive literature review was conducted according to the recommendations from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) workgroup (Moher et al., 2009). A review protocol was used that can be found in the supplemental materials. Sources were considered as eligible when they reported unique core beliefs according to the definition provided in this paper.

To obtain a complete as possible database of sources, the review was obtained in four steps: (1) A search for published articles that deals with core beliefs. (2) A manually review of these articles according to their use of the term core belief. (3) A search of the retained articles for sources which propose unique core beliefs. (4) The identification of the proposed core beliefs (dimensions and items) of these sources. Figure 1 provides a flowchart of the review process.

Figure 1

Flowchart describing identification, screening, full review, and sorting of publications and core belief items, based on PRISMA guidelines by Moher et al. (2009)


Search in "Web of Science" on 28.05.2021 for articles via the search terms "Core Belief" and "Core Beliefs", leading to 766 hits.
Updated search on 17.03.2022, leading to additional 56 hits.
Manual search within these articles, leading to additional 221 hits.
1043 articles included in the review, manually searched for their definition of core beliefs. In accordance with the definition provided in the manuscript?
No
673 articles excluded (e.g., referring to emotions, being too specific).
Yes
370 articles included. Manual search within these articles for sources which proposed and measured core beliefs.
46 sources which proposed and measured core beliefs.
Search for core belief items proposed by these sources, leading to 1111 core belief items. In accordance with the definition provided in the manuscript?
No
355 core belief items excluded.
Yes
598 items retained.
158 core belief items slightly re-phrased.
Total database of 756 core belief items.

The literature search according to step 1 was performed on 28.05.2021 using the Core Collection database of Web of Science. The two search terms "core belief" and "core beliefs" were used, searching any field. The search was updated on 17.3.2022.

All articles were manually searched for their use of the term core belief (step 2). According to inclusion and exclusion criteria (see review protocol in the supplemental materials), articles were retained if they used the term in accordance with the definition provided above. Sources that partly fulfilled the criteria were included at this stage. For example, the Brief Core Belief Scale (Fowler et al., 2006) proposed core beliefs relating to positive compared to negative valence and to self compared to others; here, positive and negative core beliefs relating to the self satisfy the inclusion criteria, but positive and negative core beliefs relating to others do not. Additionally, all articles, including the reference sections, were checked for additional articles on core beliefs that might have been missed by the search terms. This allowed for identifying and including approaches that were not labeled as core beliefs by the original authors yet referred to as such by others.

Next, articles were manually reviewed whether they proposed unique core beliefs (step 3). Articles proposing unique core beliefs were retained as sources. If an article did not propose unique core beliefs, but rather referred to existing core beliefs (e.g., an empirical study using a standardized core belief measure), the referred to article was obtained and reviewed according to the same criteria. A database was created consisting of sources that proposed unique core beliefs, including the number and content of the proposed core beliefs. Sources were categorized according to the area to which they pertained (Clinical, Developmental, Organizational, Personality, Positive, and Social-cognitive Psychology). Additionally, the number of times a source was cited was obtained as an indicator of frequency of use.

In step 4, the sources were reviewed for the proposed unique core beliefs (dimensions and items). For each of the sources, the number and name of the proposed core belief dimensions were obtained. Finally, the full item content from these sources was obtained, if available (i.e., the items developed to assess core belief dimensions). If items were not available in published articles, authors were contacted. Sources from commercial companies were included if they were made available by the owning companies either for free or for bearable expenses of up to $ 100.

All items that could be obtained were reviewed according to the same inclusion and exclusion criteria as outlined above. Specifically, all items were reviewed to assure that they comply with the definition of core beliefs as outlined in the first sentence of this paper. This accounted for sources that had only partly met the inclusion criteria as well as for instances in which core beliefs were not operationalized in line with the proposed theoretical conceptualization. Regarding the latter, some postulated core beliefs also assess emotions and behavior, a problem previously discussed in the literature (Terjesen et al., 2009). Thus, all items were manually checked. If possible, items were slightly rephrased to meet the inclusion criteria. For example, the item "I'm afraid to be betrayed even by someone I trust" (Osmo et al., 2018) was reworded to "I may be betrayed even by someone I trust" to avoid the assessment of emotions; the item "My family usually considers my feelings" (Coopersmith, 1967) was reworded to "Others usually consider my feelings" to avoid the assessment of core beliefs relating to a specific person. Items that could not be rephrased to meet the inclusion criteria without changing their prior meaning were excluded (e.g., "Others are hostile", Fowler et al., 2006). Items which were retained were further analyzed according to their semantic meaning with the methods outlined below.

Natural language processing.

Items were analyzed using Sentence-BERT (SBERT), an extension of Bidirectional Encoder Representations from Transformers (BERT) (Devlin et al., 2018) that is designed to pretrain deep bidirectional representations from unlabeled text. SBERT uses siamese and triplet network structures to derive semantically meaningful sentence embeddings (Reimers & Gurevych, 2019a). These embeddings consist of 768-dimensional dense vectors that capture the semantic meaning of a sentence. Similarity between two sentences can be obtained via cosine similarity or Pearson correlation of the two vectors representing each sentence.

Prior to extracting the embeddings, items were preprocessed by removing contractions (e.g., "I am" instead of "I'm"), capitalization, and punctuation. Embeddings for each item were then extracted via sentence transformer (Reimers & Gurevych, 2019a) in Python 3.9.7. The pretrained model *stsb-mpnet-base-v2* (Reimers & Gurevych, 2019b) was used. The model uses masked and permuted language modeling and was trained on the STS benchmark (Cer et al., 2017) dataset which includes 8628 sentence pairs from the three categories captions, news, and forums, and is based on a large diverse dataset of over 1 billion training pairs.

Statistical analyses.

A network analysis was performed based on the correlation matrix of the embeddings of the core belief items according to natural language processing. A weighted, undirected network was specified. Gaussian graphical model was used based on pairwise Markov random field using the R package *qgraph* which utilizes a graphical least absolute shrinkage and selection operator (glasso) in combination with extended Bayesian information criterion (EBIC) model selection (Epskamp et al., 2018). Interpretation was based on the location of the nodes in the two-dimensional space, weight of edges between nodes, and centrality parameters for each node. For

the latter, the strength, representing the weighted degree, was determined via the *centrality_auto* function implemented in qgraph.

A hierarchical clustering analysis was applied to cluster similar core beliefs in nuances and facets. Hierarchical clustering analysis groups items with similar properties in a step-wise procedure, starting with as many clusters as there are items, and then subsequently aggregating clusters with the highest similarity until all items are in one single cluster. On each level, two clusters are collapsed, resulting in as many levels as there are items. Clustering analysis was performed on the weight matrix of the network analysis, converted into distances, therefore representing dissimilarities between items. Clustering analysis was performed via the function *hclust* implemented in the *stats* package in R using the complete linkage method.

Multiple regression analyses were applied to estimate the shared variance between existing models of core beliefs and nuances identified via cluster analysis. Scores for nuances were estimated by averaging the embeddings across items which pertain to a nuance. To estimate scores for existing models, the original, non-rephrased items of these models were analyzed via natural language processing, as outlined above. Explained variance per nuance was estimated via adjusted R-square. Therefore, separately for each nuance, the items pertaining to an existing measure were regressed on the nuances.

Transparency and Openness

All data, code and materials are available via OSF (https://osf.io/96aed). The only exception is the full list of items, which are partly copyright protected. The investigation of the structure of core beliefs was exploratory and, thus, not preregistered.

Results

The literature performed on 28.05.2021 using two search terms "core belief" and "core beliefs" yielded 766 hits. The search was updated on 17.3.2022, leading to an additional 56 hits

(see Figure 1 for a flowchart). During the manual review of these articles (see below), 221 additional articles were identified which were considered relevant yet had not been identified by the literature search. These included articles which were not labeled as core beliefs by the original authors yet referred to as such by others. Examples include articles on automatic thoughts, schemas, world views, dysfunctional attitudes, and irrational beliefs. Thus, a total of 1043 articles were identified. A list of all articles can be found in Supplemental Material 1.

Next, these articles were manually reviewed for their use of the term *core belief*. Inclusion criterion was the use of the term *core belief* according to the definition provided above. On the other hand, articles were excluded if they did not meet one or multiple definitional criteria (see the review protocol in the supplemental materials). Accordingly, 673 articles were excluded. Sources that partially fulfilled the criteria were included.

Excluded articles.

The term "core belief" is used in many different ways. Four exclusion criteria were used (see review protocol in the supplemental materials) according to the definition of core beliefs used for the present study. In the following, representative examples illustrate the diverse use of the term and, at the same time, set the boundaries for the construct that is investigated in the present study. The review is organized around the four exclusion criteria and numbered accordingly.

(1) Some postulated core beliefs are not pure core beliefs, but also contain emotions, motivation, and behavior (Terjesen et al., 2009). This is particularly true for core beliefs developed in the context of schema therapy (Keyfitz et al., 2013; Levinson et al., 2017; Louis et al., 2018; Rodebaugh, 2009; Young, 2005). While schemas are conceptualized more broadly than core beliefs, their main point is about cognition. Given the rich and detailed literature on

schemas, they were considered as partly fulfilling the inclusion criteria and being thoroughly checked or modified on the item-level.

(2) Individuals hold core beliefs not only relating to themselves, but also relating to other people, groups, organizations, or the world in general. Examples include world views such as the world as a dangerous place or as a competitive jungle (Duckitt et al., 2002) or the belief in a just world (e.g., "I believe that in general, people get what they justly deserve"; Dalbert et al., 1987). Clifton et al. (2019) recently provided a comprehensive analyses of world views, which they labeled primals (e.g., "On the whole, the world is an uncomfortable and unpleasant place"; p. 88). Core beliefs have also been specified to describe professions, such as for leadership (Jacobs, 2017), operational and strategic management (Woods & Joyce, 2003), the attributes that characterize coaches (Abravanel & Gavin, 2017), pathologists (Jenkins et al., 2002), sex workers (Huber et al., 2019), core beliefs of rehabilitation service workforce (Mills et al., 2021), or beliefs characterizing good teachers (Miller, 2015). Also, core beliefs were proposed as pertaining to organizations (Cascio, 2006; Janson et al., 1997), like in the form of mission statements (Canning et al., 2020; Rains, 2017), core beliefs underlying talent management (Alziari, 2017), organizational strategy (Hallock, 2019), or successful schools (e.g. "all children must be treated with love, respect appreciation, and care – no exceptions allowed"; Scheurich, 1998, p. 462). Note that many definitions mention that core beliefs relate to the self, others, or the world (Beck & Beck, 2021; Dweck, 2017; Padesky, 1994). In the present study, the decision to exclude these approaches and, instead, restrict the review on a narrower definition of core beliefs of the self (within its social and cultural context) was mainly pragmatical to limit the review to a bearable scope.

(3) The term core belief is also used for beliefs that are not basic and generalized, but rather relating to specific situations, aspects of the self, events, persons, or domains. (3a) Core beliefs relating to specific situations include disorder-specific beliefs from clinical psychology such as relating to auditory hallucinations ("I am being punished for having killed someone"; Birchwood & Chadwick, 1997; Chadwick & Birchwood, 1994) or obsessive-compulsive disorder (e.g., "I belief the door handle is dirty, even though I cannot see the dirt"; Oconnor & Robillard, 1995), including thoughts about controllability (Steketee et al., 2011). In the social-cognitive literature, especially the theory of planed behavior, specific beliefs (e.g., going to the beach would be developing skin cancer; Ajzen, 1991) are assumed to influence behavioral, attitudinal, normative and control beliefs, which in turn are predictors of behavior intentions (Ajzen, 1985). Also, perceived behavioral control is not conceptualized as generalized locus of control, but rather as availability of requisite opportunities and resources (e.g., time, money, skills, cooperation of others) regarding a specific behavior such as donating for the red cross or using condoms (Fishbein & Ajzen, 2005). Another example includes research on theory of mind, which describes the ability of primates to represent what other people think or belief and involves recognizing that beliefs that others hold may be false, as investigated in the false belief task (Baroncohen et al., 1985; Dennett, 1978; Wiesmann et al., 2017). Here, beliefs relate to current state of knowledge of an agent (e.g., does the cat think that the mouse in the left or in the right box?).

(3b) Some approaches considered core beliefs only regarding specific aspects of the self. This includes cognitions about one's own thoughts such as considered in mentalizing (e.g., "I don’t always know why I do what I do"; Fonagy et al., 2016), metacognition (e.g., "I do not trust my memory"; Wells & Cartwright-Hatton, 2004), rumination (e.g., "I think about many problems without solving any of them"; Ehring et al., 2011, p. 231), self-concept clarity (e.g.,

"My beliefs about myself often conflict with one another."; Campbell et al., 1996, p. 145), or self-concept-stability (Block, 1961; Hogan, 1986; O'Brien & Epstein, 1988; Rosenberg, 1965). A second area relates to one's own emotions, such as relating to controllability, usefulness, regulation of emotions (Becerra et al., 2020; Ford & Gross, 2019; Veilleux et al., 2015), or attitudes towards emotions (Harmon-Jones et al., 2011), such as "Positive emotions are harmful" (Becerra et al., 2020; p.11). Also excluded were core beliefs related to specific symptoms, as proposed for phobias, epilepsy, eating disorders, addiction, or panic disorder, among others (see also France et al., 2015; e.g., "I am going to have a heart attack"; Greenberg, 1989; Hinrichsen, 2004; Hinrichsen et al., 2006; Hinrichsen et al., 2007; Hinrichsen et al., 2004; Martinez-Gonzalez et al., 2016; Pratt et al., 2004; Tedman et al., 1995; Tison et al., 2009). Other approaches focused on specific aspects of one's own appearance (Cash & Labarge, 1996; Gould et al., 2004; Obonsawin et al., 2017), perceptions of weight and eating (Carrard et al., 2017), the malleable of personality traits (Dweck, 2012); beliefs about own's own cognitive distortions (de Oliveira et al., 2015), and self-accusations (de Oliveira, 2011; de Oliveira et al., 2016).

(3c) Some core beliefs are considered according to specific events. In the stress literature (Lazarus & Folkman, 1984), core beliefs are conceptualized as appraisals of an event, such as producing threat and loss as opposed to opportunity for growth, mastery and gain (Ferguson et al., 1999). Other approaches focus specifically on responses to traumatic events, such as intrusive thoughts, nightmares, imagery or "stuck-points" (Botsford et al., 2019; Christianson & Marren, 2012; Weiss & Marmar, 1997). Others focused on changes in core beliefs due to a traumatic event (Berntsen & Rubin, 2006; Mechanic & Resick, 1993; Milman et al., 2022; Vogt et al., 2012), some with a special focus on post-traumatic growth (Cann, Calhoun, Tedeschi, Kilmer, et al., 2010; Cann, Calhoun, Tedeschi, & Solomon, 2010; Lindstrom et al., 2013; Tedeschi et al., 2007; Triplett et al., 2012).

(3d) Core beliefs relating to specific persons were mainly investigated in the attachment literature (Bowlby, 1969; Bowlby, 1977; Bowlby, 2005; Platts et al., 2002), relating to one or both parents (e.g., "I feel uncomfortable getting too close to my mother", Asendorpf et al., 1997; see also Sheffield et al., 2005) or close friends (Armsden & Greenberg, 1987). If possible, these core beliefs were adjusted such as reflecting cognitions about others in general.

(3e) The largest body of literature on core beliefs that was excluded from the review refers to core beliefs that pertain to a specific domain. These beliefs refer to a certain object and overlap with the concept of attitudes. Domain-specific beliefs may relate to domains such as policy, religion, environment, medicine, or education. For example, the term core beliefs is used in policy science as “fundamental policy positions concerning the basic strategies for achieving core values within the subsystem” (Sabatier & Jenkins-Smith, 1999, p. 133). These include beliefs relating to racism, antiblack stereotyping, authoritarianism, anti-Semitism, ethnicity, punishment and imprisoning, conflict and war, abortion, the justice system, or poly-culturalism (Altemeyer, 1996; Alvarez & Brehm, 1995; Anahit, 2014; Bandes & Feigenson, 2020; Bernardo et al., 2019; Beus & Dunlap, 1990; Cooper, 2005; Eisenberg, 2020; Ripberger et al., 2014; Sabatier, 1988; Stein, 2015; Tinc et al., 2021; Vilarroya & Hilferty, 2013; Waller et al., 2001). In the domain of ecology, core beliefs relating to alternative agriculture (Beus & Dunlap, 1990), regenerative energy, such as relating to wind energy (Wolsink, 2012), extinction of species (Oriordan, 1995), or environmentalism (Dunlap & Van Liere, 1978) were considered (e.g., "The balance of nature is very delicate and easily upset"; Dunlap & Van Liere, 1978, p. 21).

In the domain of religion, core beliefs refer to an interpretative structure through which individuals view their life events and frame their experiences in the context of spirituality and illness (Bell & Wright, 2015; Campbell & Golan, 2011; Chambers & Nosco, 2015; Vickers,

2010; Wright & Bell, 2009), such as beliefs that suicide is not a viable solution to problems; believes in life after death; being spiritually oriented; being close to a powerful spiritual force; or being close to god (Batson et al., 1993; Daaleman et al., 2001; Daaleman & Frey, 1999; Greening & Stoppelbein, 2002; Krumrei et al., 2013; Rosmarin, Pirutinsky, Auerbach, et al., 2011; Rosmarin, Pirutinsky, & Pargament, 2011). Core beliefs in education include, on one hand, beliefs of teachers (Rissanen et al., 2018; Williams & Klamen, 2006), including assumption about the importance of curriculum materials (Taylor, 2016), beliefs about the learning process (e.g., are there right and wrong answers in child care?, Brownlee et al., 2009), moral and ethical principles in teaching (Santoro & Morehouse, 2011), and internationality (Tate, 2013); on the other hand beliefs of learner, such as beliefs about reactions of others in the classroom (Aragao, 2011) or during public speech (Hofmann & Dibartolo, 2000p. 15), about disability and sexual orientation (Morgan et al., 2011), epistemological beliefs (Kapucu & Bahçivan, 2015), and attitudes towards the study matter (Ohlsson, 2009; Phipps & Borg, 2009; Samarapungavan & Wiers, 1997; Zeidler, 1997).

Core beliefs investigated in the domain of medicine and healthcare took different perspectives. Some approaches focused on the core beliefs of health care professionals, including method of treatment (anti-aging medicine; Fishman et al., 2010; such as biopsychosocial vs. biomedical; Nijs et al., 2013), illnesses (Yang et al., 2016), or work ethics (Nathaniel, 2006). Others focused on core beliefs of patients, such as beliefs relating to medication intake (Demyttenaere, 2001), vaccine skepticism (Browne, 2018), organ donation (Irving et al., 2012; Liu et al., 2015), illness per se (e.g., "Illness is a part of life"; Arestedt et al., 2015), complementary and alternative medicine (Goldstein, 2002), treatment methods (Cottrell et al., 2013; Meyer et al., 2013; Weitlauf et al., 2010), or exercising (Bosley et al., 2021). Additionally,

core beliefs of relatives of patients, such as relating to obligations of family members, were considered (Giles-Sims & Lockhart, 2005).

In the organizational literature, core beliefs relating to work safety (Tinc et al., 2021), work ethics (Cropley & Millward, 2009), leadership (Caldwell et al., 2002), vocational choice (Maggiori et al., 2017; Savickas & Porfeli, 2012), justice (Primeaux et al., 2003), team building (Crace & Hardy, 1997)or organizational change (Frances, 1995) were considered.

Finally, to illustrate the diversity of approaches, core beliefs have been proposed in the context of social virtual worlds (Merikivi et al., 2013), cultural differences (Hill et al., 2010; Schneider, 1998), violence criminals (Crooks et al., 2007; Dempsey & Day, 2011), or philosophy (Gheaus, 2018; McWilliams, 2016). The term core beliefs has been used as a synonym to zeitgeist, for example in architecture (Roshko, 2018), for a theoretical position, for example in philosophy (Molodet-Jitea, 2019), or for a point of view, for example in mathematics (Tennant, 2018). Highly specific core beliefs concern beliefs about the core of the earth (Jephcoat & Refson, 2001) or the constitution of a color (Roberts, 2020; Roberts & Schmidtke, 2019).

(4) As core beliefs are conceptualized as relative stable, conceptualizations as rather transient states were excluded (e.g. "This is super"; "Something has to change"; Hollon & Kendall, 1980, p. 597). This includes the concept of schema modes, moment-to-moment emotional and cognitive states and coping responses that are active at a given point in time (Goddard et al., 2022; Lobbestael et al., 2010; Young et al., 2007). Similarly, approaches were excluded which used the term as a synonym for having an idea or hypothesis (Bosworth, 2012).

Sources of core beliefs

The inclusion criterion was met by 370 articles which served as the basis for answering research question 1. These articles were checked manually for the content of the core beliefs. If articles proposed unique core beliefs, they were retained as sources. However, most of the studies did not propose unique core beliefs but rather investigated substantive questions using existing models and measures; in this case, these sources were considered. As a result, a total of 46 contributions were found. All sources can be found in Table 1.

Table 1

List of 46 sources that proposed core beliefs, along with the name of their measure, number and examples of proposed dimensions, categorized area, times cited, average amount of explained variance according to the CorBel-model (see below), and reference.

Name of the measure	Dimension	Area	Times cited	Av. adj. R^2	Reference
ABS2-SF Attitude and Belief Scale 2 - Short Version	8 (irrationality and rationality, with further subdimensions)	Clinical	3	.55	(Digiuseppe et al., 2021)
ASAP Assessment of Schema Adaptability Profile	30 (e.g., reasonable standards, self-centered)	Clinical	2	.62	(Steffen et al., 2017)
ATQ Automatic Thought Questionnaire	1	Clinical	946	.48	(Hollon & Kendall, 1980)
BCSS Brief Core Belief Scale	4 (positive vs. negative and self vs. other)	Clinical	291	.54	(Fowler et al., 2006)
BSCS Brief Suicide Cognition Scale	1	Clinical	7	.22	(Rudd & Bryan, 2021)
CBQ Core Belief Questionnaire	1	Clinical	18	.40	(Wong et al., 2017)
CCL Beck Cognitive Checklist	2 (depression and anxiety)	Clinical	452	.47	(Beck et al., 1987)
CCM-R Cognition Checklist for Mania—Revised	5 (e.g., activity, pleasure/excitement)	Clinical	12	.56	(Beck et al., 2006)
CES-R Core Extrusion Schema–Revised	2 (hidden self; rejection of the true	Clinical	9	.36	(Levinson et al., 2017)

	self)				
CSE - Core Self Evaluation	4 (e.g., locus of control; self-efficacy)	Organizational	873	.48	(Judge et al., 2002)
CSEI Coopersmith Self-Esteem Inventory	1	Social-cognitive	-	.69	(Coopersmith, 1967)
CTI Cognitive Triad Inventory	6 (positive vs. negative; self vs. world vs. future)	Clinical	77	.65	(Beckham et al., 1986)
DAS-A Dysfunctional Attitude Scale	3 (e.g., achievement, self-control/dependency)	Clinical	-	.67	(Weissman & Beck, 1978)
EDBQ Eating Disorder Belief Questionnaire	4 (e.g., negative self; acceptance by others)	Clinical	37	.50	(Cooper, CohenTovee, et al., 1997)
EBS Evaluative Belief Scale	3 (e.g., self and other statements)	Clinical	73	.60	(Chadwick et al., 1999)
FMPS The Frost Multidimensional Perfectionism Scale	6 (e.g., concern over mistakes; parental expectations)	Personality	2299	.59	(Frost et al., 1990)
GSE Generalized Self-Efficacy	1	Social-cognitive	3317	.33	(Schwarzer & Jerusalem, 1995)
IBT Irrational Beliefs Test	10 (e.g., demands for approval; dependency)	Clinical	-	.43	(Jones, 1968)
IoU Intolerance of uncertainty scale	1	Social-cognitive	905	.48	(Carleton et al., 2007)
LoC Locus of Control	3 (e.g., internality; powerful others)	Social-cognitive	-	.53	(Levenson, 1972)
LoC Locus of Control	2 (internal; external)	Social-cognitive	14	.32	(Kovaleva, 2012)
MIBS Maladaptive Interpersonal Beliefs Scale	1	Clinical	64	.42	(Boden et al., 2012)
NCB Negative Core Beliefs Inventory	5 (e.g., helpless, unloved)	Clinical	8	.66	(Osmo et al., 2018)
NfC Need for control	1	Social-cognitive	401	.46	(Burger & Cooper, 1979)
OBQ Obsessive Beliefs Questionnaire	4 (e.g., perfectionism; inflated responsibility for harm)	Clinical	68	.45	(Moulding et al., 2011)
OFS Openness to the Future Scale	1	Positive	14	.37	(Botella et al., 2018)
PBI Personality Belief Items	34 (e.g., neuroticism; agreeableness, with	Personality	38	.75	(Langston & Sykes, 1997)

	further sub-dimensions)				
PBJW Personal Belief in a Just World Scale	1	Social-cognitive	-	.38	(Dalbert, 2002)
PBQ Personality Belief Questionnaire	10 (e.g., antisocial; avoidant)	Clinical	-	.73	(Beck & Beck, 1991)
PCBQ Positive Core Belief Questionnaire	1	Positive	-	.52	(Noad, 2002)
PMBS Posttraumatic Maladaptive Beliefs Scale	3 (e.g., reliability and trustworthiness of others; threat of harm)	Clinical	39	.53	(Vogt et al., 2012)
PSQ Positive Schema Questionnaire	5 (e.g., success; trust)	Positive	33	.50	(Keyfitz et al., 2013)
PTCI Post Traumatic Cognition Inventory	3 (e.g., self; world)	Clinical	1042	.58	(Foa et al., 1999)
RSES Rosenberg Self-Esteem Scale	1	Social-cognitive	14427	.50	(Rosenberg, 1965)
SBSA Self-Beliefs Related to Social Anxiety	3 (e.g., excessively high standards for social performance)	Clinical	39	.45	(Wong & Moulds, 2011)
SCQ Self Concept Questionnaire	4 (e.g., self-image; social)	Developmental	-	.41	(Saraswat, 1984)
SCS Social Comparison Scale	3 (e.g., social rank; attractiveness)	Clinical	282	.12	(Allan & Gilbert, 1995)
SDQ III Self-Description Questionnaire III	13 (e.g., general self-esteem)	Developmental	-	.38	(Marsh, 1988)
SISE Single Items Self-Esteem	1	Social-cognitive	1753	.19	(Robins et al., 2001)
STBS Social Thoughts and Beliefs Scale	2 (e.g., social comparison; social ineptness)	Clinical	72	.42	(Turner et al., 2003)
TABS Trauma and Attachment Belief Scale	7 (e.g., trust; safety)	Clinical	-	.41	(Pearlman, 2003)
TACQ - Type A Cognition Questionnaire	3 (e.g., no universal moral principle exists; all resources are scarce)	Clinical	17	.34	(Watkins et al., 1987)
WAQ World Assumptions Questionnaire	4 (e.g., controllability of events; safety and vulnerability)	Social-cognitive	-	.50	(Kaler, 2009)
WAS World Assumptions Scale	8 (e.g., self-worth; luck)	Social-cognitive	1059	.60	(Janoff-Bulman, 1989)
YPSQ Young Positive Schema Questionnaire	14 (e.g., emotional fulfillment; healthy boundaries)	Positive	28	.68	(Louis et al., 2018)
YSQ-S3 Young Schema	18 (e.g., emotional	Clinical	102	.79	(Young, 2005)

Questionnaire	deprivation; abandonment)	

Note. Times cited was updated on 20.3.2023; some sources are not indexed in the Web of Science (e.g., unpublished manuscripts) which are denoted by '-'.

Across the 46 sources a total of 248 core belief dimensions were proposed. A full list of all dimensions can be found in Supplemental Material 2, examples are given in column 2 of Table 1. Approaches were largely diverging regarding the number, content, and assumed latent structure of core beliefs. Thirteen (28 %) approaches only proposed a single core belief dimension (e.g., Boden et al., 2012; Burger & Cooper, 1979; Hollon & Kendall, 1980; Wong et al., 2017), whereas five (11 %) proposed more than a dozen (Louis et al., 2018; Marsh, 1988; Steffen et al., 2017; Young, 2005), with the maximum being 34 (Langston & Sykes, 1997). Some approaches were very specific, proposing beliefs in relation to single syndromes or domains, such as eating behavior (Cooper, Cohen-Tovée, et al., 1997), obsessiveness (Moulding et al., 2011), anxiety (Wong & Moulds, 2011), perfectionism (Frost et al., 1990) or control (Burger & Cooper, 1979; Levenson, 1972), whereas others were broadband, aimed at describing adaptive (Louis et al., 2018) or maladaptive (Boden et al., 2012; Osmo et al., 2018) beliefs in general. Regarding area, most approaches were from clinical psychology (n = 26), followed by social-cognitive approaches (n = 11), positive psychology (n = 4), developmental psychology (n = 2), personality psychology (n = 2), and organizational psychology (n = 1). Number of times cited gives an impression of the impact of the models on their field. Number of citations varied greatly from 2 to 14427 with a median of 70. Most influential were contributions to self-esteem (Rosenberg, 1965), self-efficacy (Schwarzer & Jerusalem, 1995), and perfectionism (Frost et al., 1990). Note that number of times cited is also a function of the number of years since published and that numbers were not available if the sources were not indexed in the Web of Science.

Each of the core belief dimensions was typically operationalized by one or more brief sentences (items). The majority of approaches considered either only positive (n = 17) or only negative (n = 18) core beliefs, whereas 11 approaches considered both positive and negative core beliefs (e.g., Fowler et al., 2006). Approximately one quarter of the approaches (n = 11) conceptualized core beliefs as bipolar by using inverted items to measure low levels and non-inverted items to measure high levels of a core belief (Allan & Gilbert, 1995; Boden et al., 2012; Botella et al., 2018; Burger & Cooper, 1979; Coopersmith, 1967; Janoff-Bulman, 1989; Judge et al., 2002; Kaler, 2009; Langston & Sykes, 1997; Pearlman, 2003; Vogt et al., 2012). All other approaches refrained from the use of inverted items and considered positive and negative beliefs as separate dimensions (if both were considered, e.g., Fowler et al., 2006).

According to the manuals, the 248 core belief dimensions were operationalized by 1758 items (equaling 6.9 items per dimension on average). For 40 out of 46 sources (87%), the full item content could be retrieved by searching published material, contacting authors, and, if necessary, purchasing test materials. For one of the sources, item content was only available for one out of thirteen dimensions (Marsh, 1988). For the remaining five sources, full item content was not available as authors did not respond or had passed away (Jones, 1968; Langston & Sykes, 1997; Steffen et al., 2017; Watkins et al., 1987) or due to copyright protection (Pearlman, 2003); however, at least one sample item was available for each dimension proposed by these measures. In total, 1111 items were retrieved. Next, the inclusion criteria, as outlines above and detailed in the review protocol (see supplemental materials) were applied to these items (note that at the current point, sources were also included if they only partially fulfilled the inclusion criteria). A total of 598 items met the inclusion criteria. If possible, items that did not meet the inclusion criteria were slightly adjusted (n = 158), leading to 756 items which could be retained.

Accordingly, 355 items had to be excluded; dimensions for which all items were excluded are labeled accordingly in Supplemental Material 2.

Latent structure of core beliefs

Research question 2 was addressed by analyzing the sources in Table 1 on the item level. The 756 identified core belief items defined the construct space and were semantically analyzed for uniqueness and communalities. Using an SBERT sentence transformer, each item was mapped to a 768-dimensional dense vector space (Reimers & Gurevych, 2019a). Bivariate correlations between the vectors were computed as indicator of content similarity.

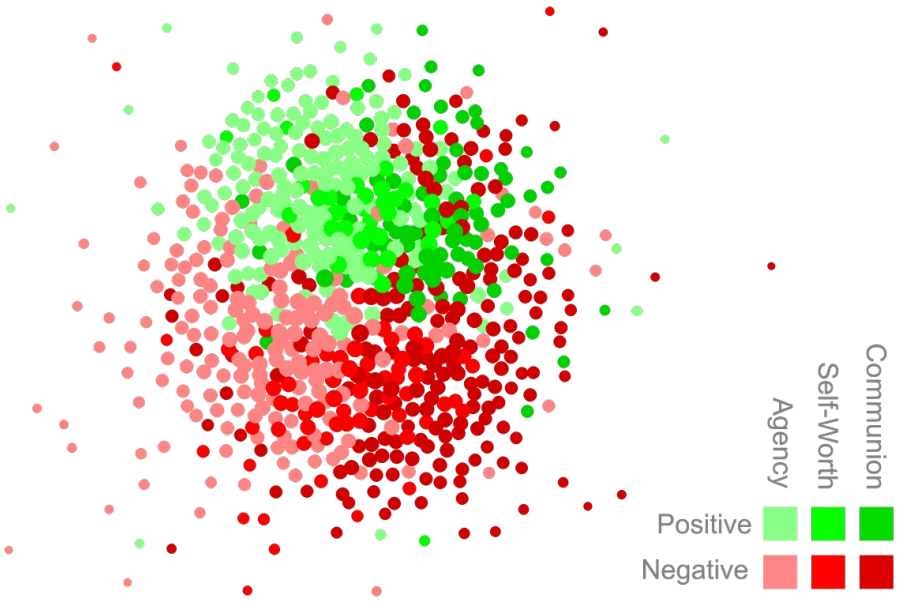
First, duplicates were identified according to pairwise correlations and visual inspection of item content. $N = 32$ items were excluded as at least one other item was a complete duplicate, as indicated by correlations of $r = 1$ between item embeddings. Additionally, eight items with bivariate correlations of $r > .95$ were additionally excluded (e.g., "At times I think I am no good at all" and "I often think that I am no good at all").

The remaining 716 items were statistically analyzed by a network analyses on the correlation matrix (Borsboom et al., 2021). Network analyses investigate the structure of items according to similarity and provide a graphical representation of items as nodes and connections between items as edges. Results are depicted in Figure 2. Inspection of the network revealed the following meaningful pattern: Items with positive valence, depicted in green, were found on the top, whereas items with negative valence, depicted in red, were mainly found on the bottom. Thus, the vertical dimension of the network could be interpreted as reflecting valence (Watson et al., 1999). However, a few items reflecting negative core beliefs were also found in the upper part of the network, distributed like a corona around the positive core belief item. These items could be interpreted as overly positive, such as entitlement and grandiosity as excessive form of

positive self-worth; perfectionism as excessive form of being ambitious; and admiration seeking as excessive form of being respected.

Figure 2

Network analysis on the SBERT embeddings of 716 core beliefs. Items with higher centrality are depicted with larger circles.



Items located in the center of the network, characterized by high centrality and strong edges to other items, could be interpreted as reflecting positive and negative *self-worth*. These items, depicted in bright green and red, respectively, contain global evaluations about the self, such as "I am good" or "I am worthless."

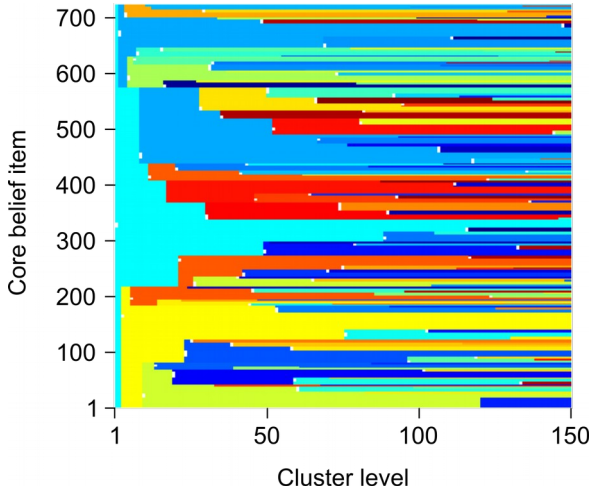
Regarding the horizontal dimension of the network, items at the left, depicted in lighter color, relate to (high and low levels of) to goal-orientation, competence, and assertiveness and were labeled as *agency*. Examples include "If I try hard I can usually do well" and "Sometimes, I do not feel in control." Items to the right, depicted in darker colors, relate to (high and low levels

of) warmth and acceptance and were interpreted as *communion* (Abele & Wojciszke, 2018). Example items include "I am usually treated fairly by other people" and "I am unlikeable."

In addition to the two broad dimensions valence and domain, the structure of core beliefs was further analyzed on a lower, more fine-grained level. Therefore, a hierarchical clustering analysis was performed on the weights from the network converted to distances (Milligan & Cooper, 1987). Hierarchical clustering analysis starts by assigning each item to a separate cluster and then continues to merge clusters step-by-step according to similarity until all items pertain to a single cluster. Results from the clustering analysis are depicted in Figure 3. The 716 items are visualized on the ordinate axis, sorted according to clustering analysis. On the abscissa, the level of clustering is shown for the first 150 (out of 716) levels. Items that are clustered together on a given level are shown in the same color. For example, on level 3, items in yellow (at the bottom) pertain to negative self-worth and negative agency; items in blue (at the top) to negative communion; and in cyan (in the middle) to positive beliefs. Clusters were further broken down until they consisted of narrow, homogenous beliefs (depicted with small white bars in Figure 2). In very few instances, natural language processing clustered beliefs on superficial (rather than substantial) characteristics (e.g., "Other people seem to accept lower standards than I do" and "Other people are more competent than I am") or on antonyms (e.g., "I'm able to discipline myself to complete routine or boring tasks" and "I have a very difficult time sacrificing immediate gratification or pleasure to achieve a long-range goal"). Thus, the clusters were thoroughly revised. As a result, a total of 97 clusters (from here on referred to as *nuances*) with up to 15 items each (5.8 items on average) were identified. Nuances can be interpreted as smallest unit that cannot be further broken down. The nuances, together with short definitions, are depicted in Supplemental Table 1.

Figure 3

Results from hierarchical cluster analysis. Items (on the ordinate axis) were clustered step-by-step according to similarity until all items pertained to a single cluster (cluster level 1). Items in the same cluster are shown in the same color. Clusters were broken down into 97 narrow nuances, depicted with small white bars.



Finally, the latent structure of core beliefs was analyzed on an intermediate level between nuances and domains. Therefore, similarities and dissimilarities of nuances were investigated according to network weights, joint clusters on higher levels, bivariate correlations, and conceptual overlap (see Supplemental Material 3). As a result, the 97 nuances were aggregated into nineteen facets. Description of the facets can be found in Table 2. Nuances pertaining to each facet can be inferred from the last column in Supplemental Table 1.

Table 2

Description of facets of core beliefs. Facets are on an intermediate level between narrow nuances and high-bandwidth dimensions of domain (as indicated in rows) and valence (as indicated in columns).

	Positive	Negative
Agency	Competent: Being capable and competent to accomplish; proud of something	Incompetent: Being foolish, non-competent, useless, dull, a failure
	Autonomous: Being in control, efficient, determined, self-reliant, and disciplined; believing to succeed	Insecure: Lacking control, confidence, and discipline; avoiding problems; having self-doubts; being unsafe
	Optimistic: Expecting good things to happen; having great plans for the future; being lucky	Pessimistic: Expecting bad things to happen; being hopeless and pessimistic about the future
	Moderate: Having moderate standards; not being bothered by frustrations, not being too strict when making mistakes	Unrelenting: Setting extremely high goals; must be perfect on everything; failing and mistakes cannot be tolerated
Self-Worth	Worthy: Being good and worthy; having a positive attitude towards myself; being as good and worthy as others	Unworthy: Being bad, worthless, weak, and inferior to others
		Admired: Being special, better than others
Communion	Accepted: Being socially acceptance, liked by others, loved, and securely attached	Rejected: Being non-liked and non-respected; being alone, lost, and unloved
	Trusting: Being treated fairly and just by others; trusting and relying on others	Untrusting: Expecting others to take advantage of or leave me; hiding and withdrawing from others; being alien and better of alone
	Serene: Not caring what others think of myself; not in need of approval from others	Pleading: Seeking approval and admiration, depending on others; being concerned what others think of me; being self-sacrificing

	Considerate: Taking care of myself in accordance with the needs of others; accepting others positions and wishes	Ruthless: Being selfish, manipulating, and disobedient; being impeded and controlled by others; disregarding rules

An integrated structural model of core beliefs

According to the results of network and cluster analyses, the structure underlying core beliefs can be described on three different hierarchical levels: High-fidelity nuances; intermediate-level facets; and high-bandwidth dimensions of domain and valence. Figure 4 provides a schematic model of the identified latent structure. The 97 nuances are arranged in a two-dimensional space near the location of the underlying items according to the network analysis (see Figure 2). The color of the nuances pertains to domain and valence, as in Figure 2; the acronyms are explained in Supplemental Table 1. Facets are depicted in grey. The model is named *CorBel*; despite being an abbreviation, the name points to a function of core beliefs which mirrors the function of its namesake in architecture, namely, to operate as fundamental elements for a structure.

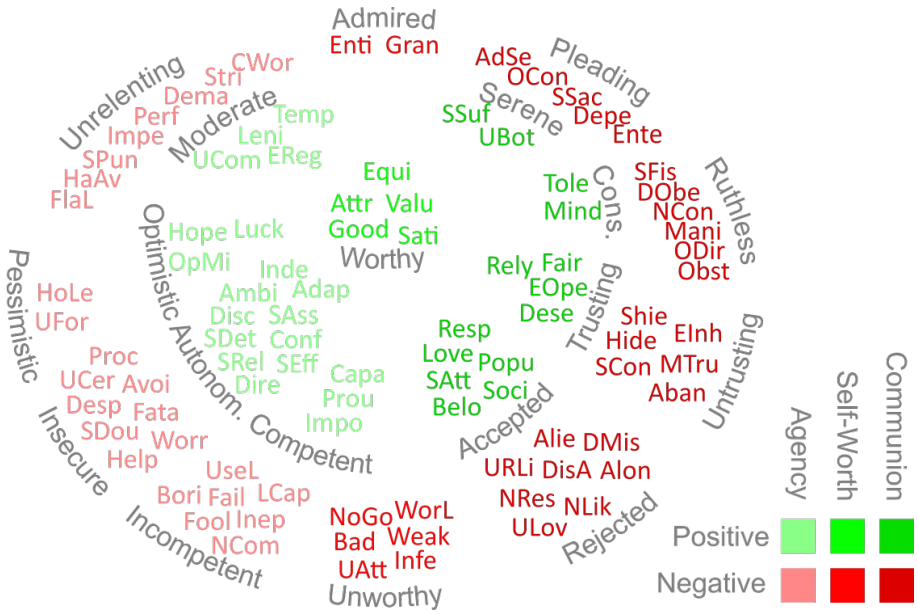
The model can be summarized as follows: Positive beliefs, depicted in green, can be found in the center and upper part of the model. Negative beliefs, depicted in red, are mainly found in the lower part of the model, as well as in the outermost upper region. Negative beliefs in the lower part correspond to low levels of positive beliefs, whereas negative beliefs at the top correspond to unreasonable, deviant, excessive, or overly positive beliefs. Domains are arranged horizontally, with core beliefs relating to self-worth in the center, agency to the left, and communion to the right.

The domain self-worth consists of three facets. The facet worthy can be found in the center of the positive beliefs and includes nuances such as being good, satisfied, equivalent, and valuable. The facet unworthy contains corresponding negatives beliefs and is depicted at the

bottom. It includes nuances of being bad, weak, no-good, and worthless. The facet admired, depicted at the top of the model, relates to excessively high self-worth and includes the nuances of being entitled and grandiose.

Figure 4.

The CorBel model, a schematic model of the structure of core beliefs. Nuances are depicted via four-letter acronyms (see Supplemental Table 1). Facets are depicted in grey. Nuances with higher similarity are depicted in closer proximity according to the network model depicted in Figure 2.



In the lower left area, three pairs of facets relating to agency can be found. The first pair of corresponding facets is labeled as competent versus incompetent and consists of nuances such as being capable and proud as compared to inept, useless, and foolish. The next pair of facets is autonomous versus insecure, indicated by beliefs of being confident, self-efficient, and adaptive as compared to helpless, uncertain, and avoiding. Next are two small facets, with only five nuances in total, relating to an optimistic versus pessimistic view of the future.

In the upper left is the facet unrelenting, which relates to excessive levels of ambition and rigor. It includes nuances related to being strict, perfectionistic, and demanding. The facet corresponds to the positively-valenced facet of being moderate, which describes the absence of unrelenting beliefs and contains nuances such as being lenient, tempered, and uncomplaining.

In the lower right are two pairs of facets pertaining to communion. The first pair of corresponding facets relate to being accepted versus rejected and includes nuances of being loved, belonging, and popular as compared to being unloved, alone, and alien. Next are the facets of being trusting versus untrusting, which consist of nuances related to being treated fairly and relying on others as compared to being mistrusting, self-conscious, and shielding.

In the upper right are facets related to deviant or inappropriate social behavior. The facet ruthless includes the nuances of being selfish, non-conforming, disobedient, and manipulating. It corresponds to the positively-valenced facet considerate with the nuances tolerant and mindful. Finally, the facet of being pleading includes facets such as admiration-seeking, self-sacrificing, or being concerned what others think. It corresponds to positive beliefs of the facet serene, with the nuances of being self-sufficient and unbothered about what others think.

Bandwidth of existing models of core beliefs

The CorBel models allows for re-visiting research question 1 separately for each of the sources in Table 1. If one assumes that the CorBel-model is an approximation of the construct space of core beliefs, then it can be used as a benchmark to evaluate existing models regarding their coverage of the construct space. This also allows for a well-informed choice of a model and a corresponding measure according to a given use case. Therefore, separately for each measure and each nuance, the embeddings of the items pertaining to a measure were regressed on a nuance via multiple regression and adjusted R^2 served as estimator of explained variance. Results

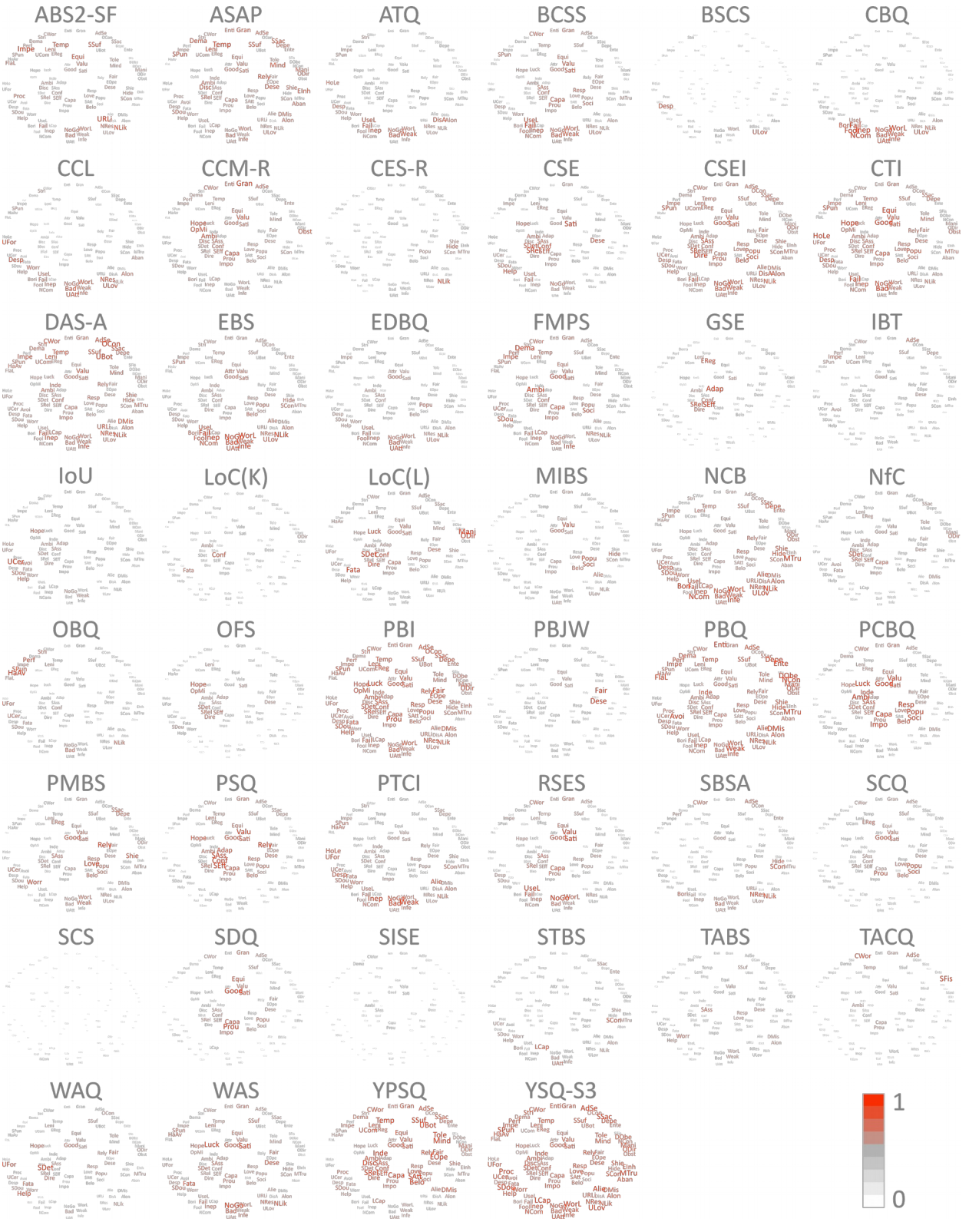
are depicted as heat plot in Figure 5. The average amount of variance explained across the 97 nuances is given in Table 1.

Results show large differences between sources. Large average amount of variance (average adjusted $R^2 > .70$) was explained by the Assessment of Schema Adaptability Profile (ASAP) and the Personality Belief Items (PBI); both models have many dimensions and consider both positive as well as negative core beliefs. The Young Positive Schema Questionnaire (YPSQ) and the Young Schema Questionnaire (YSQ-S3) also explained large amount of variance in nuances (average adjusted R^2 of .68 and .79, respectively). Heat maps in Figure 5 show, however, that, in line with their conceptualization, the former mainly explains variance in positive nuances, the latter in negative nuances.

Models with very low amount of explained variance include the Social Comparison Scale (SCS) which assesses personal beliefs in relation to others (and, accordingly, shows some overlap with the nuance inferior); the Single Items Self-Esteem scale (SISE), which has only one item relating to self-esteem; and the Brief Suicide Cognition Scale (BSCS) which only relates to the nuance desperate (all average adjusted $R^2 \leq .20$).

Figure 5.

Multiple correlations between the dimensions of a measure and each nuance, according to embeddings of natural language processing. Higher values indicate that a nuance is assessed by the respective measure. See Table 1 and Supplemental Table 1 for abbreviations.


ABS2-SF
ASAP
ATQ
BCSS
BSCS
CBQ
CCL
CCM-R
CES-R
CSE
CSEI
CTI
DAS-A
EBS
EDBQ
FMPS
GSE
IBT
IoU
LoC(K)
LoC(L)
MIBS
NCB
NfC
OBQ
OFS
PBI
PBJW
PBQ
PCBQ
PMBS
PSQ
PTCI
RSES
SBSA
SCQ
SCS
SDQ
SISE
STBS
TABS
TACQ
WAQ
WAS
YPSQ
YSQ-S3
1
0

Finally, some measures are very specific, thus relating to only a few nuances. As such, the Core Belief Questionnaire (CBQ) is only related to nuances incompetent and unworthy; the General Self-Efficacy scale (GSE) to nuances of the facet autonomous; the Intolerance of uncertainty scale (IoU) to nuances of the facet insecure; the Obsessive Beliefs Questionnaire (OBQ) to nuances of the facet unrelenting; the Personal Belief in a Just World Scale (PBJW) to nuances of the facet trusting; the Rosenberg Self-Esteem Scale (RSES) to nuances of the facet worthy; and the Type A Cognition Questionnaire (TACQ) to the nuances conditionally-worthy and selfish.

Discussion

The present research was inspired by recent claims that core beliefs constitute an important psychological construct which allows better understanding and explanation of individual differences and personality traits (Dweck, 2017; Geukes et al., 2018; Langston & Sykes, 1997). However, in personality psychology, only a few core beliefs were thus far considered, mainly stemming from the social-cognitive literature (e.g., self-esteem; locus of control). A review of the literature revealed that core beliefs have been investigated in many areas of psychology. These approaches are currently disconnected and differ largely regarding bandwidth and fidelity.

The review revealed that core beliefs were extensively researched in clinical psychology, but also in the fields of health and positive psychology, attachment, development and learning, organizational behavior, or political psychology, among others. These accounts currently stand unconnected to one another. In the present research, an attempt was made to identify these approaches and to integrate them within a comprehensive, eclectic structural model. The proposed model accomplishes an integration of the scattered literature on core beliefs. It provides

a description of their latent structure on different hierarchical levels: With its 97 nuances, it allows for a fine-grained analysis of individual core beliefs, whereas higher levels allow for measuring broader patterns of core beliefs which may be more appropriate to predict equally broad criteria (Wittmann, 1988).

Core beliefs in psychology

Regarding research question 1, the systematic literature review on more than a thousand papers revealed 46 unique sources which proposed one or multiple core beliefs. These approaches were very heterogenic, differing in the number, content, assumed latent structure, and conceptualization of core beliefs. Many approaches were selective, by focusing only on specific core beliefs. On the other hand, more general approaches lacked differentiated dimensions on lower levels (e.g., Fowler et al., 2006). Together, the 46 sources proposed a total of 248 core belief dimensions, some of which overlapped, while others were unique.

According to the current results the Young Schema Questionnaire is based on the most comprehensive model (Young, 1999). The items pertaining to its 18 dimensions explained on average 79 % of the variance in core belief nuances. Note, however, that the model only considers negative core beliefs, such that positive beliefs are only measured indirectly as low levels of corresponding negative beliefs. Additionally, even some of the negative beliefs were not well represented (e.g., selfish). Other models showed considerably less construct saturation, with an average of 49%. Given this situation, a comprehensive assessment and investigation of core beliefs is currently difficult to obtain.

The review also revealed that the term core belief is used in very different ways. Many studies used the term as not basic and generalized, but rather relating to specific situations, aspects of the self, events, persons, or domains, such as political or environmentally related beliefs. Such beliefs strongly overlap with the concept of attitudes. Additionally, the term was

sometimes used in a broader sense, containing also emotions, motivation, and behavior (Terjesen et al., 2009). On the other hand, core beliefs (as defined in the present research) were also proposed under different names, including automatic thoughts, schemas, working models, and assumptions (Bowlby, 1969). This situation can be described as a jingle-jungle-fallacy (Block, 1995): Jingle refers to different constructs receiving the same label and jangle refers to almost identical constructs being labeled differently. The present review contributed towards a clarification by providing a clear definition of core beliefs, yet considering approaches that went under different names yet were referred to as core beliefs in the published literature.

The structure of core beliefs

An analysis on the item level revealed that the structure of core beliefs can be described on different hierarchical levels: High-fidelity nuances; intermediate-level facets; and high-bandwidth dimensions of domain and valence. The identified structure was integrated in a graphical, network-based model, referred to as CorBel model which incorporates the full spectrum of previously proposed core beliefs.

Nuances describe the lowest, most differentiated level of analysis (Mottus et al., 2019). Sometimes even equated with single items, they consist of a single aspect that cannot be broken down further. Correspondingly, the items pertaining to the nuances identified in the present research are highly similar, sometimes consisting of paraphrasing. With its 97 nuances, the CorBel model is more differentiated as any existing model. As a comparison, the most differentiated model encompasses 34 unique core beliefs (Langston & Sykes, 1997). Thus, the level of nuances allows for a fine-grained analysis of core beliefs.

On the highest level, a two-dimensional structure with the dimensions domain and valence was found. Regarding domains, agency and communion reflect two major dimensions of interindividual differences (Abele & Wojciszke, 2018; Judd et al., 2005). First proposed by

Bakan (1966), they have also been referred to as competence and relatedness (Sheldon, 2004) or getting ahead and getting along, respectively (Hogan, 1982). These two domains were complemented by a third domain, self-worth (Robins et al., 2001). The latter is more general, pertaining to global evaluations of the self. Core beliefs related to self-worth accordingly showed the highest centrality in the network.

Regarding valence, note that approximately one quarter of the sources reviewed considered beliefs as bipolar, i.e., a single dimension with negative beliefs as inverted indicators of corresponding positive belief (e.g., Langston & Sykes, 1997). However, this view is not undisputed. First, most of the reviewed sources refrained from using inverted items. Second, the network analysis in the present study had clear evidence of positive and negative beliefs as separate entities along the vertical dimension of the network. Third, while a few pair of positive and negative beliefs might be expected to be bipolar (e.g., good versus bad), for other beliefs, the correspondence between positive and negative beliefs was less clear (e.g., admiration-seeking and being unbothered) or a directly opposing belief was not found at all (e.g., for the nuance hiding or the facet admired). Fourth, a valence factor was also proposed for other constructs, such as positive and negative affect (Watson et al., 1999). Finally, there is empirical evidence that positive and negative beliefs operate functionally different. For example, positive schemas showed incremental validity over negative schemas for a range of criteria, including satisfaction with life, well-being, depression, or stress (Louis et al., 2018; Wood et al., 2008, 2009).

Within the two dimensions of domain and valence, a further distinction could have been made regarding an activity- or arousal-related tendency (Higgins, 1997). Specifically, within negative beliefs, core beliefs at the bottom (e.g., insecure, rejected, untrusting) are characterized by lower levels of activity or approach compared to core beliefs at the top (e.g., demanding,

grandiose, manipulating). An opposite pattern with higher levels of activity and approach at the bottom (e.g., capable, directing) compared to the top (e.g., lenient, unbothered) can be found for positive beliefs. This structure corresponds to Watson and Tellegen's circumplex model of mood which structures mood on the two dimensions of engagement and pleasantness (Watson & Tellegen, 1985). The dimension valence of the CorBel model mirrors the pleasantness-dimension. Including a dimension corresponding to activity or engagement would have required a more complex model with three dimensions, which would have considerably diminished the interpretability of the model. Nonetheless, such a dimension might be psychologically meaningful.

On an intermediate level of generality, beliefs were clustered in nineteen facets, nested in the dimensions of domain and valence. Facets provide a more differentiated description as broad dimensions while being more parsimonious compared to nuances. This level was the most difficult to achieve, which is mirrored by empirical studies reporting diverging solutions for intermediate-level factor structure (see Kriston et al., 2012). Indeed, while both according to the data and to theorizing some nuances are more related to each other than others, such relations might be due to different processes. Accordingly, different solutions might be obtained. For example, the nuance conditionally-worthy shares the aspect of excessive levels of ambition and rigor with beliefs from the facet unrelenting; the aspect self-worthy with the same names domain; and the aspect of conditionality with the nuance entertaining. Additionally, while some nuances showed strong associations with other nuances (e.g., alien, alone, and non-liked), others had no close relations to any other nuance (e.g., emotionally-inhibited; open-minded). Nonetheless, the facets proposed by the CorBel are generally in line with results from empirical factor analyses (Bach et al., 2017; Chioqueta & Stiles, 2006; Elliott & Lassen, 1997; Hoffart et al., 2005; Keyfitz et al., 2013; Lee et al., 1999; Osmo et al., 2018; Saariaho et al., 2012; Soygüt

et al., 2009; Young et al., 2003). Still, the proposed structure is in need for empirical validation in future research.

Natural language processing in psychology

It was not until the very recent years that natural language processing made such tremendous advances that allowed for performing complex, language-based tasks that were thus far only accomplishable by humans. Examples include translation of text into dozens of different languages; spelling correction; search for counterfeit products; text generation, text classification, or text extraction. These algorithms are now part of our day-to-day life, for example when using search engines or interacting with chat bots and even have the capability to write poems on pre-defined terms or programming a website from a handwritten sketch.

For the present research, a sentence transformer was used that was developed as a fast and powerful extension of Bidirectional Encoder Representations from Transformers (Devlin et al., 2018; Reimers & Gurevych, 2019b). These transformers map the semantic content of a sentence onto a large vector (here with 768 dimensions) such that the angle between vectors reflects semantic similarity of the underlying sentences. Exactly these similarities are the cornerstone of hierarchical structural models in personality psychology according to the sedimental hypothesis (Allport, 1937). A similar application that has been developed unknowingly in parallel recently showed that the correlational pattern of adjectives analyzed with natural language processing shows a highly similar structure to that of empirical data and allowed a replication of three major factors of personality (Cutler & Condon, 2022). As a major benefit, these approaches allow for analyzing large batteries of items without the need for error-prone manual preprocessing. However, the extent to which the current approach equates to human self-reports requires further investigation. In general, natural language-based correlations were larger than typical empirical covariances, which might reflect error-related variance in the

later. Additionally, in some instances, correlations between positively and negatively coded items were large, reflecting the similar content of the items, but not the valence. Finally, a very few items were misunderstood by the algorithm (e.g., relying on other people for most things as relying rather than being dependent). As such, results required careful inspection. That being said, the natural language processing data was an invaluable resource for the present research endeavor, reducing the amount of nearly 300.000 possible pairwise comparisons between the 756 items to the inspection of items pre-clustered in 97 nuances. Nonetheless, future research is necessary to systematically investigate the benefit and boundaries of these approaches for personality psychology and psychological diagnostics.

Limitations and Outlook

The present study is based on a narrow definition of core beliefs, particularly by defining them as cognitions about what individuals think about themselves including social and cultural context. The latter includes, for example, beliefs in the context of social interaction or according to social norms; however, the belief is always about the self. Broader definitions also conceptualized core beliefs regarding others and the world in general (Beck, 1970; Dweck, 2017; Young, 1999), such as considering others as hostile, or the world to be a safe place (Duckitt et al., 2002). One reason for this decision was pragmatic to reduce the amount of literature to be reviewed to a bearable size. Additionally, core beliefs about the world in general have recently been summarized under the label of primal world beliefs using a comprehensive bottom up approach (Clifton et al., 2019). No comparable approach currently exists for core beliefs relating to others, pointing to a potential avenue for future research.

Currently, the CorBel model is a theoretical model that is not operationalized by a corresponding, validated measure, even though the items from existing measures that were analyzed might serve as a resource for item development. Also outstanding, as noted above, is an

empirical validation and potentially modification of the CorBel model, which would require the availability of such a measure.

The CorBel model has the potential for being applied in basic and applied sciences, for example to investigate how needs transfer to characteristic patterns in goal-orientated behavior and, ultimately, normal as well as abnormal variations in personality (Dweck, 2017; Geukes et al., 2018), as well as for individual diagnoses, counseling, and therapy. In clinical settings, the integrative model, consisting of both positive and negative beliefs, allows for a broadened perspective that supplements a deficient-oriented perspective on maladaptive beliefs with an additional consideration of positive beliefs according to a resource-oriented perspective (Grawe, 1997; Grawe & Grawe-Gerber, 1999). With its general approach, it might contribute towards transferring clinical knowledge to sub-clinical counselling or health prevention applications. On the individual level, the graphical, network-based representation might be a benefit for providing feedback and quickly identifying personal strength and weaknesses.

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Autor Note

Data, materials, and code availability

All data, code and materials are available via OSF (https://osf.io/96aed). The only exception is the full list of items, which are partly copyright protected.

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There are no competing interests to report.

Preregistration

The investigation of the structure of core beliefs was exploratory and, thus, not preregistered.

Transparency and Openness Promotion (TOP)

The manuscript conforms with level 2 of the Transparency and Openness Promotion (Nosek et al., 2015).

Supplemental Materials

Review protocol

Review objective

The systematic review has two main objectives, summarized in the following research questions:

Research questions 1: Which core beliefs have been proposed in the literature?

Research Question 2: How can the latent structure of core beliefs be described on different hierarchical levels?

Study design

The research questions are answered based on studies which proposed core beliefs. Core beliefs must be named and operationally defined either in terms of a formal definition or by explicating the core belief (i.e., by giving the full text of the core belief). Typically, core beliefs were proposed in studies with a substantial research question for which core beliefs were considered; in theoretical studies on the structure of core beliefs; and in measurement studies aimed at developing psychometric measures to assess core beliefs.

Inclusion criteria

Studies were included if they proposed core beliefs according to the working definition provided in this manuscript:

Core beliefs are basic, generalized, and relatively stable cognitions that reflect what individuals think about themselves within their social and cultural context (Beck, 1970; Dweck, 2017; Young, 1999).

Exclusion criteria

Accordingly, articles were excluded if they did not meet one or multiple definitional criteria. These excluded articles referred to core beliefs in at least one of the following ways:

(1) not as a cognition, but rather as emotion, motivation, or behavior (e.g., "I find it embarrassing to express my emotions to others" (Young, 1994);

(2) not referred to themselves, but rather to others (e.g., "I believe that in general, people get what they justly deserve") (Dalbert et al., 1987) or the world in general (e.g., "On the whole, the world is an uncomfortable and unpleasant place") (Clifton et al., 2019);

(3) not as basic, generalized, but rather as relating to…

(3a) a specific situation (e.g., "I believe the door handle is dirty, even though I cannot see the dirt" or "The devil will drive me mad if I don't obey" or "I am going to have a heart attack") (Birchwood & Chadwick, 1997; Greenberg, 1989; Oconnor & Robillard, 1995);

(3b) a specific aspect of the self (e.g., "I do not trust my memory"; Wells & Cartwright-Hatton, 2004)

(3b) a specific event (e.g., "This event permanently changed my life") (Berntsen & Rubin, 2006; Cann, Calhoun, Tedeschi, Kilmer, et al., 2010);

(3c) a specific person ("I feel uncomfortable getting too close to my mother") (Asendorpf et al., 1997);

(3d) a specific domain (e.g., "God is compassionate towards human suffering" or "The balance of nature is very delicate and easily upset") (Dunlap & Van Liere, 1978; Rosmarin, Pirutinsky, Auerbach, et al., 2011);

(4) not as relatively stable, but rather as a transient state ("This is super") (Hollon & Kendall, 1980).

Language

Core beliefs in the English language were considered. This also includes Core beliefs that were initially developed in other languages but also available in English. The decision was made to assure that both the researchers as well as the natural language processing approach can understand the core beliefs.

Publication type/status

Sources were considered if published in peer-reviewed journals, reports, book chapters, conference abstracts, and theses. Sources from commercial companies were included if they were made available by the owning companies either for free or for bearable expenses of up to $ 100,--.

Search strategy

To obtain an as compete as possible database, the search includes four steps: (1) A search for published articles dealing with core beliefs. (2) A manually review of these articles for their use of the term belief according to the inclusion and exclusion criteria outlined above. Articles are retained if they meet the inclusion criteria. Additionally, articles, including the reference section are searched for additional published articles which were missed by the search under (1). (3) A search for articles proposing unique core beliefs. If an article retained under (2) proposes unique core beliefs, it is added as a source. If the article does not propose unique core beliefs but rather refers to existing core beliefs (e.g., an empirical study that uses previously developed measures), then these sources were obtained and reviewed according to the same criteria. (4) Sources identified under (3) are searched for proposed core beliefs (i.e., dimensions and items of core belief measures).

Data extraction

For each source, the number and name of the proposed core beliefs are obtained (i.e., typically the dimensions of standardized core belief measures). For measures with multiple versions the most recent version is considered. Additionally, the area from which a source originates is coded according to the following categories: Clinical, Developmental, Organizational, Personality, Positive, and Social-cognitive Psychology. Finally, the number of times a source is cited is obtained as an indicator of frequency of use.

Next, all items developed to measure these core beliefs are obtained, if possible. Items are included if the meet the inclusion and exclusion criteria, as outlined above. If possible, items which do not meet the inclusion criteria are slightly reworded such that they meet the inclusion criteria yet retain their original meaning. All included items are further analyzed according to their semantic meaning using natural language processing.

Supplemental Table 1.

Description of 97 core belief nuances. Nuances were identified through network and cluster analyses according to natural language processing of 716 core beliefs. Valence, domain, and facet refer to higher-level dimensions on which nuances can be aggregated.

Nuance	Description	Valence	Domain	Facet
Aban	Abandoned: Others will leave me	negative	Communion	Untrusting
Adap	Adaptable: Efficiently dealing with new and unforeseen situations	positive	Agency	Autonomous
AdSe	Admiration-Seeking: Seeking approval and admiration from others	negative	Communion	Pleading
Alie	Alien: Being an outsider, different from others	negative	Communion	Rejected
Alon	Alone: Being alone and lost	negative	Communion	Rejected
Ambi	Ambitious: Being an achiever	positive	Agency	Autonomous
Attr	Attractive: Considering myself good-looking	positive	Self-Worth	Worthy
Avoi	Avoiding: Avoiding problems and unpleasant situations	negative	Agency	Insecure
Bad	Bad: Considering myself to be a bad person	negative	Self-Worth	Unworthy
Belo	Belonging: Being accepted by and part of a group	positive	Communion	Accepted
Bori	Boring: Being uninteresting and dull	negative	Agency	Incompetent
Capa	Capable: Being a competent person	positive	Agency	Competent
Conf	Confident: Believe to succeed if I try hard	positive	Agency	Autonomous
CWor	Conditionally-Worthy: Must show achievements to be a worthy person	negative	Agency	Unrelenting
Dema	Demanding: Setting extremely high goals	negative	Agency	Unrelenting
Depe	Dependent: Being dependent on others for	negative	Communion	Pleading

	their assistance			
Dese	Deserving: Usually getting what I deserve	positive	Communion	Trusting
Desp	Desperate: No hope to change anything to the better	negative	Agency	Incompetent
Dire	Directing: Directing others according to my ideas	positive	Agency	Autonomous
DisA	Disappearing: Wishing to disappear from the world	negative	Communion	Rejected
Disc	Disciplined: Disciplined striving for long-term goals	positive	Agency	Autonomous
DMis	Dismissing: Being better of alone	negative	Communion	Rejected
DObe	Disobedient: Rebelling against expectations being placed on me	negative	Communion	Ruthless
EInh	Emotionally-Inhibited: Have to hide my emotions	negative	Communion	Untrusting
Ente	Entertaining: Have to entertain others so they like me	negative	Communion	Pleading
Enti	Entitled: Being special and expecting to be treated accordingly	negative	Self-Worth	Admired
EOpe	Emotionally-Open: Am comfortable showing my emotions	positive	Communion	Trusting
Equi	Equivalent: Being as good and worthy as other people	positive	Self-Worth	Worthy
EReg	Emotionally-Regulated: Being able to regulate my emotions	positive	Agency	Moderate
Fail	Failure: Being a failure as a person	negative	Agency	Incompetent
Fair	Fair: Being treated fairly and just by others	positive	Communion	Trusting
Fata	Fatalistic: Cannot control what is going to happen	negative	Agency	Insecure
FlaL	Flawless: Making mistakes is a catastrophe	negative	Agency	Unrelenting
Fool	Foolish: Being stupid and dumb	negative	Agency	Incompetent

Good	Good: Considering myself a good person	positive	Self-Worth	Worthy
Gran	Grandiose: Being better than others	negative	Self-Worth	Admired
HaAv	Harm-Avoidant: Being overly careful to avoid harm	negative	Agency	Unrelenting
Help	Helpless: Not in control of my life	negative	Agency	Insecure
Hide	Hiding: Expecting that others might reveal the "real" me	negative	Communion	Untrusting
HoLe	HoLe: Being hopeless and pessimistic about the future	negative	Agency	Pessimistic
Hope	Hopeful: Expecting that things will turn out well	positive	Agency	Optimistic
Impe	Impelled: Failing cannot be tolerated	negative	Agency	Unrelenting
Impo	Important: Having something to contribute	positive	Agency	Competent
Inde	Independent: Being an independent person	positive	Agency	Autonomous
Inep	Inept: Being inadequate and defective	negative	Agency	Incompetent
Infe	Inferior: Being inferior compared to others	negative	Self-Worth	Unworthy
LCap	Less-Capable: Others are more competent	negative	Agency	Incompetent
Leni	Lenient: Not being too strict when making mistakes	positive	Agency	Moderate
Love	Loved: Being loved by someone	positive	Communion	Accepted
Luck	Lucky: Considering myself a lucky person	positive	Agency	Optimistic
Mani	Manipulating: Pleasing people above me to get what I want	negative	Communion	Ruthless
Mind	Mindful: Taking care of myself in accordance with the needs of others	positive	Communion	Considerate
MTru	Mistrusting: Expecting others to take advantage of me	negative	Communion	Untrusting
NCom	Non-Competent: Being non-competent in most	negative	Agency	Incompetent

	things			
NCon	Non-Conforming: Disregarding rules	negative	Communion	Ruthless
NLik	Non-liked: Being someone who cannot be liked by others	negative	Communion	Rejected
NoGo	No-Good: Being no good as a person	negative	Self-Worth	Unworthy
NRes	Non-Respected: Not being respected by others	negative	Communion	Rejected
Obst	Obstructed: Being impeded by others when striving to get what I want	negative	Communion	Ruthless
OCon	Other-concerned: Being concerned what others think of me	negative	Communion	Pleading
ODir	Other-Directed: Being controlled by powerful others	negative	Communion	Ruthless
OpMi	Open-Minded: Having great ideas and plans for the future	positive	Agency	Optimistic
Perf	Perfect: Must be perfect on everything	negative	Agency	Unrelenting
Popu	Popular: Being liked by others	positive	Communion	Accepted
Proc	Procrastinating: Can't discipline myself to fulfill my obligations	negative	Agency	Insecure
Prou	Proud: Having something to be proud of	positive	Agency	Competent
Rely	Relying: Trusting and relying on other people	positive	Communion	Trusting
Resp	Responsible: Being a responsible and trustworthy person	positive	Communion	Accepted
SAss	Self-Assure: Believing and trusting in myself	positive	Agency	Autonomous
Sati	Satisfied: Having a positive attitude towards myself	positive	Self-Worth	Worthy
SAtt	Securely-Attached: People close to me will not abandon me	positive	Communion	Accepted
SCon	Self-Conscious: Expecting negative	negative	Communion	Untrusting

	evaluation by others			
SDet	Self-Determined: Controlling what will happen in my life	positive	Agency	Autonomous
SDou	Self-Doubting: Insecure about handling everyday problems	negative	Agency	Insecure
SEff	Self-Efficient: Dealing well with challenges and problems	positive	Agency	Autonomous
SFis	Selfish: Being selfish even at the expense of others	negative	Communion	Ruthless
Shie	Shielding: Protect myself from others	negative	Communion	Untrusting
Soci	Sociable: Being sociable and easy to like	positive	Communion	Accepted
SPun	Self-Punishing: Deserving punishment for making mistakes	negative	Agency	Unrelenting
SRel	Self-Reliant: Taking control of myself	positive	Agency	Autonomous
SSac	Self-Sacrificing: Too much doing for and thinking about others	negative	Communion	Pleading
SSuf	Self-Sufficient: Don't need approval from others	positive	Communion	Serene
Stri	Strict: Can't accept good enough	negative	Agency	Unrelenting
Temp	Tempered: Having moderate standards	positive	Agency	Moderate
Tole	Tolerant: Accept others positions and wishes	positive	Communion	Considerate
UAtt	Unattractive: Being physically unattractive	negative	Self-Worth	Unworthy
UBot	Unbothered: Not caring what others think of myself	positive	Communion	Serene
UCer	Uncertain: Lacking confidence to do the right thing	negative	Agency	Insecure
UCom	Uncomplaining: Not worrying or being bothered by frustrations	positive	Agency	Moderate
UFor	Unfortunate: Expecting bad things to happen	negative	Agency	Pessimistic

ULov	Unloved: Being an unloved and unlovable person	negative	Communion	Rejected
URLi	Unreturned Liking: Disapproval of being disliked by people who are important to me	negative	Communion	Rejected
UseL	Useless: Being a useless person	negative	Agency	Incompetent
Valu	Valuable: Being a valuable and worthy person	positive	Self-Worth	Worthy
Weak	Weak: Being a weak and helpless person	negative	Self-Worth	Unworthy
WorL	Worthless: Being a worthless person	negative	Self-Worth	Unworthy
Worr	Worried: Being unsafe or trapped	negative	Agency	Insecure

Supplemental Material 1 (separate file)

List of articles from the comprehensive literature review. The second column indicates whether articles were included or excluded according to the inclusion criteria (see Method section).

Supplemental Material 2 (separate file)

Full list of all dimensions of core beliefs proposed by the 46 sources depicted in Table 1. Sources were included if they at least partially adhered to the working definition provided in the manuscript. Dimensions which did not adhere to the inclusion criteria according to an inspection of the items are labeled accordingly in the last column.

Supplemental Material 3 (separate file)

Full table of bivariate correlations between nuances. Nuances are sorted according to facet. For abbreviations, see Supplemental Table 1.