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Reviewing Radicalization Research Using a Network Approach

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Abstract
In an effort to discern determinants of political radicalization, scholars have discussed and investigated a considerable number of personal or contextual constructs. Yet the existing literature reviews on this topic have mainly focused on specific data sources and research approaches (e.g., survey research), whereas an integrative overview is still missing. This study provides a systematic review of 57 published studies while particularly focusing on differences in the prevalence of considered determinants across research approaches (i.e., survey approaches, experimental approaches, and digital trace data approaches). As an innovative approach to systematic review, we apply a network approach for analyzing the most prevalent constructs and related hypotheses in the literature. Network analysis is particularly useful in this context because, it allows the visualization of the structure of constructs and hypotheses proposed in the field as well as the identification of crucial concepts. The review reveals differences across empirical approaches and closes with a discussion of over- and underresearched constructs, their generalizability across research approaches, and potentials for future research. We conclude by recommending a stronger integration of constructs and perspectives as well as a more rigid consideration of causal inference.

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Reviewing radicalization research using a network approach

In an effort to understand the causes of violent extremism, alongside how it develops and persists, a plethora of research was produced (Horgan, 2008). Notwithstanding the intense interest in the issue of radicalization, the field still lacks a coherent understanding of the structures and cognitive and emotional processes by which some individuals come to adopt

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extremist ideologies and engage in ideologically motivated violence (Borum, 2011; Sageman, 2014; Wolfowicz, Litmanovitz, Weisburd, & Hasisi, 2019). Recent research has begun to investigate causal mechanisms (e.g., the role of criminogenic constructs such as low self-control or social control, see Opp, 2019). Extant research on radicalization has been characterized by a lack of applied empirical methods or a focus on selective populations (e.g., mainly focusing on radical Islamists, see Klausen, Campion, Needle, Nguyen, & Libretti, 2016), and a narrow focus on the choice of dependent variables (e.g., only studying successfully committed violent acts) (cf. LaFree, Jensen, James, & Safer-Lichtenstein, 2018).

Because studies on political radicalization are extremely diverse, an overview of the various scientific perspectives, constructs, hypotheses, and analytical approaches would lay the groundwork for cumulating knowledge and enable the creation of guidelines for future research. In recent years, a number of review papers have been published (Desmarais, Simons-Rudolph, Brugh, Schilling, & Hoggan, 2017; Hassan, et al., 2018; McGilloway, Gosh, & Bhui, 2015; Pelzer, 2018; Vergani, Iqbal, Ilbahar, & Barton, 2018) that shed light on the current state-of-the-art. Some reviews have a broad focus, covering different radicalisation risks, protective constructs or correlates (Christmann, 2012; Lösel, King, Bender, & Jugl, 2018; Wolfowicz et al., 2019), while a smaller number focus on a specific selection of constructs, such as social cohesion (Grossman & Tahiri, 2015). Likewise, some systematic reviews attempted to evaluate the psychometric properties of existing measurement instruments, such as Scarcella and colleagues' (2016) investigation of risk assessment tools, which mainly focused on self-reports of attitudes toward terrorism, extremism, or radicalization. While having tremendously increased the knowledge in the field, limitations of these reviews include their focus on specific data sources and research approaches (e.g., self-report research), whereas an overall integrative overview is missing.

Of the aforementioned reviews, the meta-analysis by Wolfowicz et al. (2019) is the most comprehensive approach to date. The authors quantitatively summarized effect sizes of 57 studies referring to 60 individual level protective and risk factors for radical attitudes, intentions, and behaviours. The study resulted in a rank-order of effect sizes. The present

study seeks to build on this meta-analysis. Whereas Wolfowicz et al. (2019) provided solid evidence about the strengths of relationships, our study approaches the field by analyzing the complex structure of all considered theoretical constructs and hypotheses formulated by scholars of the field. This is achieved by applying a network approach (Van de Wijngaert, Bouwman, & Contractor, 2014; Wasserman & Faust, 1994), that allows us to visually represent the whole field, with its constructs represented by nodes and its hypotheses represented as directed edges connecting the nodes. The network analysis also enables us to identify central constructs and hypotheses, to compare the network of constructs and hypotheses across research approaches and, thus, to identify facilitators and limitations for testing certain hypotheses. Most importantly, the network analysis provides a basis for future research as it can help to identify crucial constructs to generate causal models and to make decisions about necessary control variables. By doing so, our paper contributes to the growing literature on causal modelling (e.g., Pearl, 2009; Shrier & Platt, 2008). A second goal of the study is to compare the network structure and, thus, analyse differences in relevance and interconnections of constructs across methodological approaches (e.g., survey research, experimental research and social media research). As our study focuses on hypotheses and theoretical perspectives in the field with an emphasis on their structure, we provide an additional unique perspective on the field that fruitfully adds to the quantitative results provided by the meta-analysis by Wolfowicz et al. (2019). By doing so, our study shows the unique value and, thus, the synergetic potential of both quantitative meta-analyses and network approaches.

Background

Radicalization research: Determinants and research approaches

Recently, research on political radicalization has become of tremendous interest for scientists and politicians as well as the general public. Especially crimes and terror attacks in cities like New York, Brussels, Christchurch, El Paso, or Paris, and an increased polarization

of political discourse and ostentatious displays of emotional outrage on social media channels have led researchers to increase their efforts in the investigation of potential determinants of radicalization processes.

Despite the intense interest in the issue of radicalization, establishing a generic approach to examining the phenomenon has been hindered by the heterogeneous and ambiguous conceptualization of "radicalization" in relation to concepts like "terrorism," and "extremism" (Schmid, 2013). Pathways into violent extremism are multilevel and involve factors spanning macro-, meso-, and micro- levels of analysis, combining intra- and interindividual dynamics and societal processes, while some factors are consistently reported across different contexts and across various ideological and political hues.

While the main focus of this research is the development of violence-promoting attitudes and beliefs or behaviors, existing studies diverge in their focus on potential determinants or chosen research approaches. Research on radicalization is motivated by the interest in the causal processes leading to extremism, not only to understand social and cognitive processes leading to society-endangering perspectives, but also as a means to develop potential interventions.

To organize determinants, it is helpful to rely on multilevel theory (see Franc & Pavlovic, 2018; Schmid, 2013). From this perspective, determinants located on the *micro-level* reflect psychological constructs such as factors that comprise moral and cognitive propensities (e.g., authoritarianism), personality constructs (e.g., low self-esteem), demographic characteristics, experiences that increase the propensity to form extremist attitudes (traumatic events, military experiences), or political or religious affiliations. Determinants on the *meso-level* relate to the milieu of the radicalizing person and, in particular, concern the processes and characteristics of the social groups or the influence of significant others. This social environment acts as a socialization background and serves as the surroundings for normative influences, the transfer of critical information, as well as emotional support and reinforcement of beliefs and attitudes. Finally, *macro-level* determinants are characteristics or events on the regional or societal level, for instance,

globalization and modernization (leading to alienation from values of society or loss of credibility of government and state structures) and foreign policy interventions (perceived as foreign occupation). Additionally, objective markers of inequality (e.g., national poverty) can exacerbate the subjective perception of deprivation and injustices.

Beyond the differences in their focus on a variety of constructs, studies have applied different research approaches to test hypotheses. Most research mainly applied *survey* approaches, to measure psychological constructs, such as personality traits, perceptions of deprivation, group threat, or uncertainty (Doosje, Loseman, & Van den Bos, 2013). Others measured psychological health (e.g., Bhui et al., 2019) or the prevalence of radical attitudes in the general population (Loza, 2011). In contrast, *experimental approaches* attempted to manipulate experiences of discrimination and deprivation and investigated their impact on radicalization-prone attitudes or behavior (e.g., Dechesne, 2009), or analyzed the influence of media consumption on extremist attitudes (e.g., Frischlich, Rieger, Hein, & Bente, 2015). The studies, focusing on *digital trace data*, gathered data from either social media platforms (e.g., postings on Facebook, or Twitter) or open sources (e.g., databases like PIRUS or ECDB, which contain coded information on individual background characteristics, based on media reports or government documents). This type of studies investigated radicalization processes as a result of discrimination and deprivation experiences (e.g., Mitts, 2019) or attempted to identify users with radical attitudes (e.g., Egan et al., 2017). Others compared the demographic or psychological profile of different groups (e.g., of "lone wolves," gangs, converts, or types of offenses; e.g., Kerodal, Freilich, & Chermak, 2016; LaFree et al., 2018).

The use of network theory for the integration of research

For decades, there has been an ongoing discussion on how to synthesize the literature to integrate the diverse perspectives, analytical approaches, and conclusions. While the most original form of a *narrative review* has been, and still is, an important source of orientation for a field, its subjective character has led to criticisms with regard to the selection biases when searching for and collecting articles or the subjective biases of the reviewer when

interpreting and integrating the research (e.g., Tranfield, Denyer, & Palminder, 2003). As a result of these criticisms, a strong focus on *systematic reviews* emerged, especially in medicine and related fields that focus on evidence-based decision processes (Pawson, 2006; Sacket, Rosenberg, Gray, Haynes, & Richardson, 1996; Tranfield, et al., 2003). Likewise, to quantitatively summarize research results and to investigate the heterogeneity in the field with regard to the results, *meta-analyses* have become widespread (Cooper, 2013). Finally, there are approaches to systematically compare theoretical frameworks used in a field (Opp & Wippler, 1990).

In contrast to the established approaches, the application of network theory and related analytical procedures, as a means to summarize the perspectives, hypotheses, and constructs held in a scientific field, is new (Van De Wijngaert et al., 2014; McGlashan, Johnstone, Creighton, de la Haye, & Allender, 2016). Networks are used in a number of different fields and for analyzing different phenomena, ranging from, *social groups and dynamics* (e.g., Borgatti, Mehra, Brass, & Labianca, 2009; for social capital, see Burt, 2000), *communication structures* (Bavelas, 1950), *construct definitions and measurement* (e.g., application to psychopathological constructs, see Borsboom & Cramer, 2013), to *causal inference* (e.g., directed acyclic graphs, see Elwert, 2013; Pearl, 2009). As explained later in detail, the gist of these different applications is that agents or entities (e.g., persons, symptoms, or constructs) can be described with regard to their structural relationships to other agents or entities. These structural relationships can represent interpersonal relationships, logical connections, or causal effects, and the overall system can be described by a *graph* that represents the structure of *nodes* (e.g., persons, variables) and *edges* as their connections (relationships, causal relations). In recent decades, network theory has been associated with a host of analytical procedures to derive and analyze properties of the whole graph (i.e., on the graph-level of analysis) and to identify important nodes by their location in the network (i.e., on the node-level of analysis).

Van De Wijngaert et al. (2014) emphasized the merits of applying network theory for the purpose of integrating research in a field. From this perspective, a research field focusing

on some phenomenon can be represented as a graph which consists of nodes, representing constructs (e.g., radical attitude or personality traits) and the edges representing the hypotheses held in the field. Whereas overall network theory allows edges to be either undirected or directed, an edge in the present network-based review is always directed and represents a causal hypothesis formulated in the field. Figure 1 represents an example. In the figure, a directed edge linking personality and extremist attitudes would represent the hypothesis of one or several studies that some personality trait has a causal effect on radical attitudes. Furthermore, the different number of posed hypotheses can be visualized by the degree of thickness of edges referring to the node. Differences in the prevalence of certain constructs under consideration can be illustrated by the size of the nodes. In this example, Figure 1 indicates that the field was dominated by hypotheses focusing on the role of extremist attitude for extremist behavior whereas the examined papers seldom hypothesized the role of demographics.

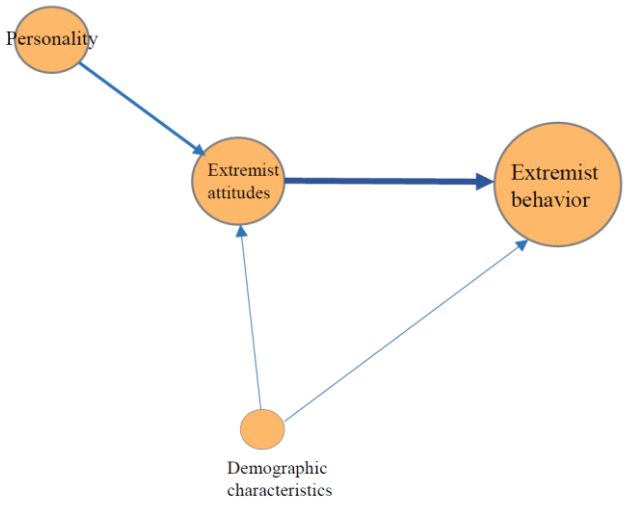

Figure 1: Exemplary network structure

Beyond the intuitive appeal of representing an entire field in one graph, a wide array of network analytical methods can be applied to quantitatively characterize the domain and to identify central constructs. Finally, the structure of the graph can be used to inform the field about potential opportunities to generate causal models (Elwert, 2013), including mediating processes (MacKinnon, Fairchild, & Fritz, 2007) or to reduce the danger of confounding bias (Vanderweele, 2019). For instance, from the network in Figure 1, one could conclude that extremist attitudes mediate the effect of personality on radical behavior (cf. Ajzen, 2005) or that demographic characteristics—due to their joint effect on extremist attitudes and behavior—confound the relationship between both. An important implication of the approach is that parts of the network may stem from exclusive sets of studies, in which some studies focused solely on one relationship, but not on others.

Finally, the network approach provides a basis to decide whether sampling specific subpopulations with a specific profile or values of some variable (e.g., focusing on only individuals already radicalized) is appropriate in order to avoid endogenous selection bias (Elwert & Winship, 2014). In this regard, Elwert and Winship suggest caution when selecting subsamples on the basis of some dependent variable.

The present study represents an attempt to use network theory to integrate the extant research on radicalization to form a global network structure that illustrates the current state of thinking as well as the dominant and less dominant constructs and hypotheses. By creating different networks for the diversely used research approaches (i.e., survey research, experimental research, and research using online trace data), network analysis allows us to identify approach-specific constructs and perspectives in radicalization research.

Methods

Inclusion criteria, search strategy, and screening

Our inclusion/exclusion criteria and search strategy drew on Wolfowicz et al. (2019) who used the two-pyramid model (McCauley & Moskalenko, 2017). That is, in a similar vein, we

distinguished cognitive and behavioral radicalization and considered radical attitudes, intentions and behaviors as useful determinants and outcomes in the radicalization process. Likewise, the choice of relevant databases was informed but not limited by those of former meta-analyses. We applied the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) reporting standards to describe the search flow and screening results and guarantee transparency (see Figure 2). To identify papers, we searched in five databases and search engines (e.g., *PubPsych*, *Medline*, *PsycINFO*, *SSRN*, *ISI Science*, *ACM Digital Library*, *JSTOR*, *The Campbell Collaboration Library*, *NCJRS*) together with handsearching (e.g., *Voxpol Network of Excellence*, *International Centre for Counter-Terrorism* [ICCT] or *Perspectives on Terrorism*) (for further details on search strategies, see Appendix A and C). We focused on the literature spanning a 15-year publication range (2004 – 2019), reflecting the point at which the concept of "radicalization" started to appear more frequently in literature (Neumann & Kleinmann, 2013).

We included studies which had applied (i) empirical research approaches or analysis that formulated explicit hypotheses (digital behavioral trace data, self-reports or experiments); (ii) focused on the following forms of radicalization: political extremism (e.g., right-wing or left-wing extremism), religious fundamentalism (e.g., Islamism), nationalist/separatist extremism, "single-issue" extremism (e.g., environmental protection or abortion), or ideologically independent extremism; (iii) focused on populations in the U.S. and the European region, in order to guarantee comparability by similar cultures and economic prerequisites (cf. Zhirkov, Verkuyten, & Weesie, 2014). The selection of studies included those that had focused on violent manifestations of radicalization (e.g., violence-promoting beliefs, attitudes, intentions, or behaviors) as well as its determinants. This differentiation of behavior and beliefs connects to the issue that the latter is much vaguer which in turn extends the scope of possible measures targeting beliefs (cf. Wolfowicz et al., 2019). In contrast, we excluded studies that solely investigated broader attitudes or dispositions (e.g., right-wing authoritarianism or social dominance) without direct connection to radicalization. Due to the comparable search terms, databases, and inclusion criteria, we ended up with a sample with a

large overlap especially with the meta-analysis by Wolfowicz et al. (2019) providing the opportunity to integrate their results with the results of the network approach.

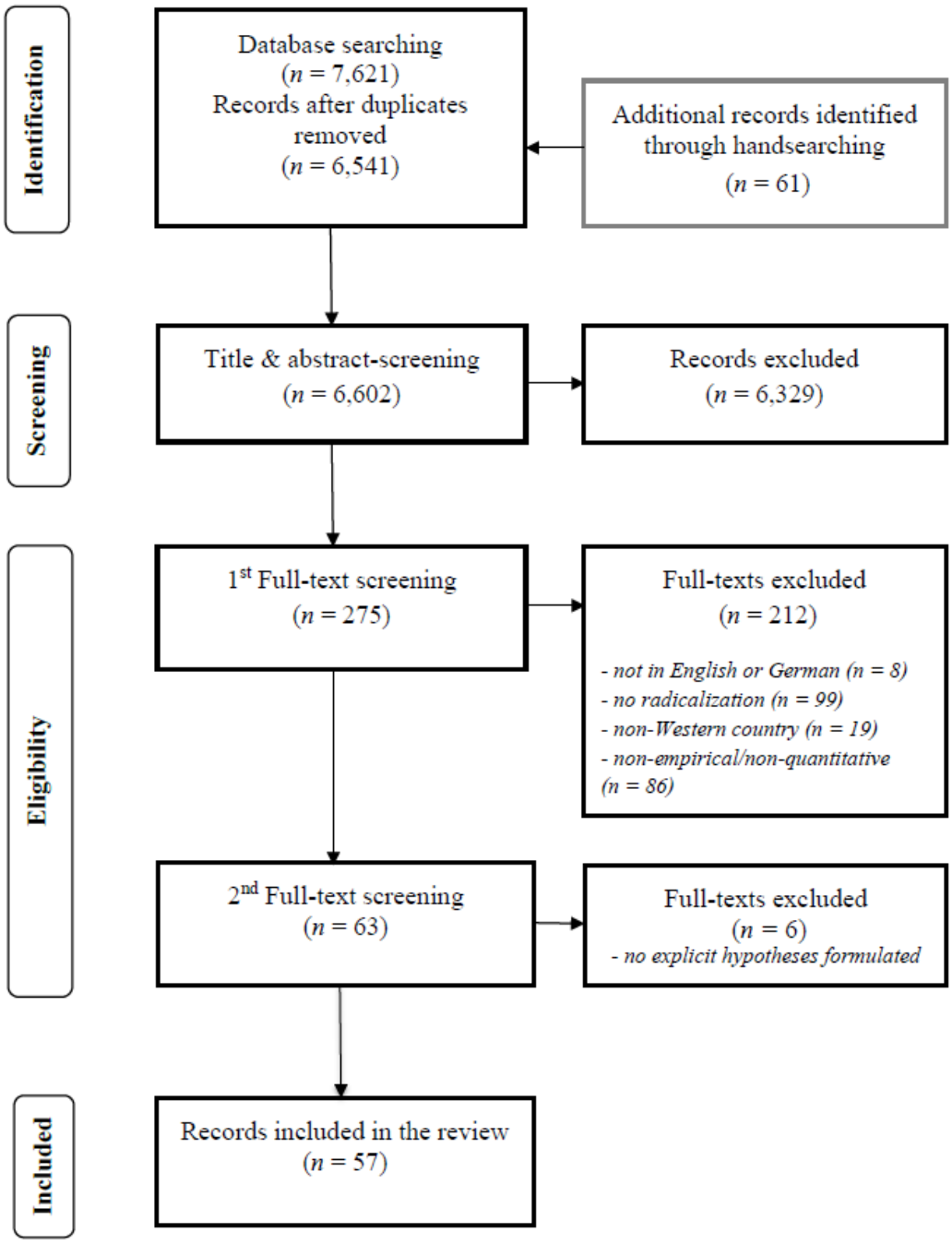

Figure 2: Flow chart of the literature search following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines

Network measures

We calculated various forms of centrality measures to analyze properties of the nodes (i.e., the analyzed constructs) in the network. Overall, the centrality concept reflects the importance of a node in the network, resulting from its location and structure of relationships to other nodes. Applied to our context, a high-centrality construct would reflect the prominence and importance of a certain radicalization construct. The centrality measures we take into consideration are *in-degree centrality, out-degree centrality, closeness centrality,* and *betweenness centrality*. In addition to the brief explanation provided here, Appendices B and D formally define each measure, present a short explanation of each measure, and summarize the theoretical relevance for our context.

In-degree centrality ($D^{+}(v)$). This measure reflects the number of directed edges the target node receives. Applied to our context, a construct with high in-degree centrality is often conceptualized as a dependent variable.

Out-degree centrality ($D^{-}(v)$). This measure reflects the number of directed edges originating from the target node. Applied to our context, a construct with high out-degree centrality is often hypothesized as a causal determinant of other constructs.

Closeness centrality (C_v). Closeness centrality is the most intuitive measure on the importance of a target node and is defined as the reciprocal of the sum of paths by which the node is connected to all other paths. At an extreme, a node may be directly related to all other nodes, thus, resulting in a closeness centrality value of 1. The more other nodes the target node has to pass to reach another node, the lower the closeness centrality and the lower the numerical value. In our context, a construct exhibiting a strong closeness centrality is one that is the main focus of all the research examined here as illustrated by the fact that many hypotheses directly address this construct.

Betweenness centrality ($B(v)$). Betweenness centrality reflects the "broker" or bridging" function of a node connecting otherwise disconnected partitions of a network. In particular, a high betweenness centrality occurs when the target node is located within many indirect connections between other nodes. This concept has become popular in Burt's (2000)

structural holes theory that describes the conditions of high-power individuals in complex networks. Applied to our context, target constructs with a high betweenness centrality are powerful bridge builders between distant constructs and may reflect either *mediators* (i.e., variables, transmitting an effect from the cause to the outcome), *confounders* (i.e., variables that affect two target variables and create a spurious relationship), or *colliders* (i.e., variables that are mutually influenced by two variables) (Elwert, 2013). Hence, identifying those constructs provides a fruitful basis for guiding future research with regard to clarifying the potential causal role of the respective construct.

Network density. On the level of the network, we analyzed the *density* of the network, which reflects the density or scarcity of hypotheses in the field. A dense network is a network in which the number of edges is close to the maximum. A network with small number of ties is called scarce. The density of a network is calculated by dividing the number of edges in the network by the number of edges possible, in case the network is a completely linked network. It ranges around values between 0 and 1 in the binary number system. The 0 value demonstrates that there are no ties between constructs. Applied to the area of systematic reviews, a dense research field implies lack of parsimony (Van De Wijngaert et al., 2014), that is, a proliferation of constructs without integration into an overall framework with common pathways and mediating processes.

Analytical procedure

Coding of articles. We coded the articles according to four categories of information: (i) the analyzed constructs, that is, constructs on the micro-level (i.e., individual-related constructs), meso-level (i.e., group and relationship-related constructs), and macro-level (i.e., societal constructs), (ii) information about the hypotheses, and (iii) the chosen research approach (i.e., survey approaches, experimental research, and digital trace data approaches).

To organize the constructs and to analyze the constructs and hypotheses with a network model, we aggregated constructs to higher-level constructs. Table 1 depicts the constructs extracted from the studies and the higher-order constructs.

Table 1
Coding of categories extracted from hypotheses and their respective definitions

Construct	Higher-order construct
Individual-related constructs (micro-level)	
Non-violent behavior (e.g., protest, support for non-violent organizations)	Activism
Criminal activity before radicalization (conviction, violence against property or people)	Criminal history
Potential trauma, triggering events, abused childhood	Critical events
Gender, age, marital status, ethnicity, citizenship	Demographics
Stable individual traits (personality, intelligence, self-control, coping skills, need for order, extroversion, risk seeking, authoritarianism)	Dispositions
Genetic factors	Genetics
Search for purpose in life, significance, uncertainty avoidance	Meaningfulness
Military training and serving military services	Military experience
Psychological disorder or chronic impairment of wellbeing or social functioning (mortality salience, psychosis proneness, depression)	Psychological health
Ideology, support for instrumental violence (voice grievances, desire to hurt others, opposition to equality, persuasiveness of radical content)	Radical attitudes
Violent (attempted) offense (e.g., bombing) or unusual behavior (e.g., travel abroad, lifestyle changes, risky behavior), delinquency	Radical behavior
Religious membership (e.g., Christianity)	Religious affiliation
Attitudes toward duties and morality (e.g., self-sacrifice for a higher cause)	Religious beliefs
Religion-related behaviors (e.g., prayer frequency, conversion, mosque attendance)	Religious practices
Education, income, employment, status seeking	Social status
Emotional responses and sensitivity (e.g., situational hatred, frustration, affective valence)	State
Drug or other substance consumption or addiction	Substance abuse
Group and relationship-related constructs (meso-level)	
Commitment and loyalty, or development of close group relationships (ingroup identification, gang member, social support)	Cohesion
Shared beliefs and attitudes, biases in evaluation of events or people (ingroup superiority, symbolic threat, collective relative deprivation)	Group processes
Connectedness to family and intimate relationships and social	Significant others

control	
Rejection or exclusion by the group or individual representatives of a group (target of prejudices, socially isolated)	Social exclusion
Peer pressure, recruiting or influence of information sources/narratives (propaganda consumption, epistemic authority figures, peer immersion, lexical homophily)	Social influence
Societal constructs (macro-level)	
Dual (ethnic) identity, alienation or distance to people and mainstream society (perceived identity incompatibility)	Integration
Population-level estimates of disadvantage: economic (GDP, poverty rate) or sociopolitical (political participation, share of foreign-born residents, hate crimes)	Objective inequality
Individual perceptions of deprivation: economic (income dissatisfaction) or sociopolitical (legal cynicism, anti-government beliefs, unfair treatment by police, religious suppression)	Subjective inequality

Note. Examples for categories extracted (left column) are nonexhaustive

Analyses. After data extraction, the hypotheses were transformed into a "node and edge list," which contained the pair of the respective independent and dependent variables implied in the hypothesis and the unique ID of the respective studies to enable referring the study to additional attribute information (e.g., the applied research approaches). The order of the pairing is meaningful, as it indicated which construct was hypothesized as an independent variable and which was hypothesized as a dependent variable. After creating the node and edge list, we calculated the network measures (e.g., *betweenness centrality).* The network statistics were calculated using the igraph package in the software R (R Core Team, 2018). The edge and node list was imported in the open-source network visualization software Gephi (https://gephi.org/).

Results

Descriptive results

The data extraction led to a total of 57 articles containing 777 constructs which—when aggregated to 25 higher-order constructs (see Table 1)—resulted in 244 hypotheses containing a unique combination of independent and dependent constructs.

Table 2 shows the number of studies and the number of constructs considered in the three research approaches. Overall, the majority of studies (k = 27) applied a survey approach and used self-report questionnaires to measure target constructs whereas 14 studies conducted experiments and 16 gathered trace data. Survey studies predominantly measured demographic variables (k = 15) or social status (k = 16) as these variables are easily measured via self-report and reflected research that aimed at targeting at-risk individuals on the basis of these surface-level indicators. Likewise, studies with a survey approach often measured radical attitudes and intentions (k = 27) or dispositions (k = 13), as these constructs, due to their subjective nature, are suitable for measurement by self-reports. Constructs belonging to the "integration" category (k = 14) were exclusively investigated by self-reports and referred, for instance, to dual identity and perceived identity incompatibility (see Simon, Reichert, & Grabow, 2013).

Table 2
Number of studies across higher-order constructs and research approaches

Construct	Research approaches		
	Survey approaches	Experimental approaches	Trace data approaches
Individual-related constructs (micro-level)			
Activism	1	3	3
Criminal history	4	0	4
Critical events	5	2	5
Demographics	15	1	6
Dispositions	13	8	5

Meaningfulness	7	4	1
Military experience	0	0	5
Psychological health	6	3	4
Radical attitude	27	11	12
Radical behavior	8	3	8
Religious affiliation	7	0	1
Religious beliefs	8	3	2
Religious practices	5	0	3
Social status	16	0	7
State	1	8	1
Substance abuse	2	0	2
Genetics	1	0	0
Group and relationship-related constructs (meso-level)			
Cohesion	6	4	9
Group processes	10	2	2
Significant others	3	0	5
Social exclusion	11	2	6
Social influence	9	2	6
Societal constructs (macro-level)			
Integration	14	0	0
Objective inequality	9	0	3
Subjective inequality	18	3	5
Total number of studies	27	14	16

Constructs considered in the category of *experimental* approaches were either experimentally manipulated (e.g., the experience of social exclusion, see Pretus et al., 2018) or measured as an outcome or covariate. Analogously, the constructs considered most frequently were dispositions (k = 8) and radical attitudes and intentions (k = 11) (e.g., perceived persuasiveness of radical content or the advocacy of violence for political goals), or emotional states (e.g., situational hatred or frustration, k = 8).

The studies that had collected *digital trace data* from social media and open sources (k = 16) focused on the role of cohesion in groups (k = 9), for instance, established in open sources through extremist group membership or movement-related tattoos (see Kerodal et al., 2016). Similarly, radical behavior figured prominently in open sources (k = 8), distinguishing pre-attack behavior, lifestyle changes, and types of crimes (spontaneous vs. planned, offenses against property vs. civilians) (see, e.g., Corner & Gill, 2014; Sweeney & Perliger, 2018). On behalf of social media records, constructs reflecting radical attitudes comprised positive statements about ISIS ideology or expressed threats against others (see Mitts, 2019).

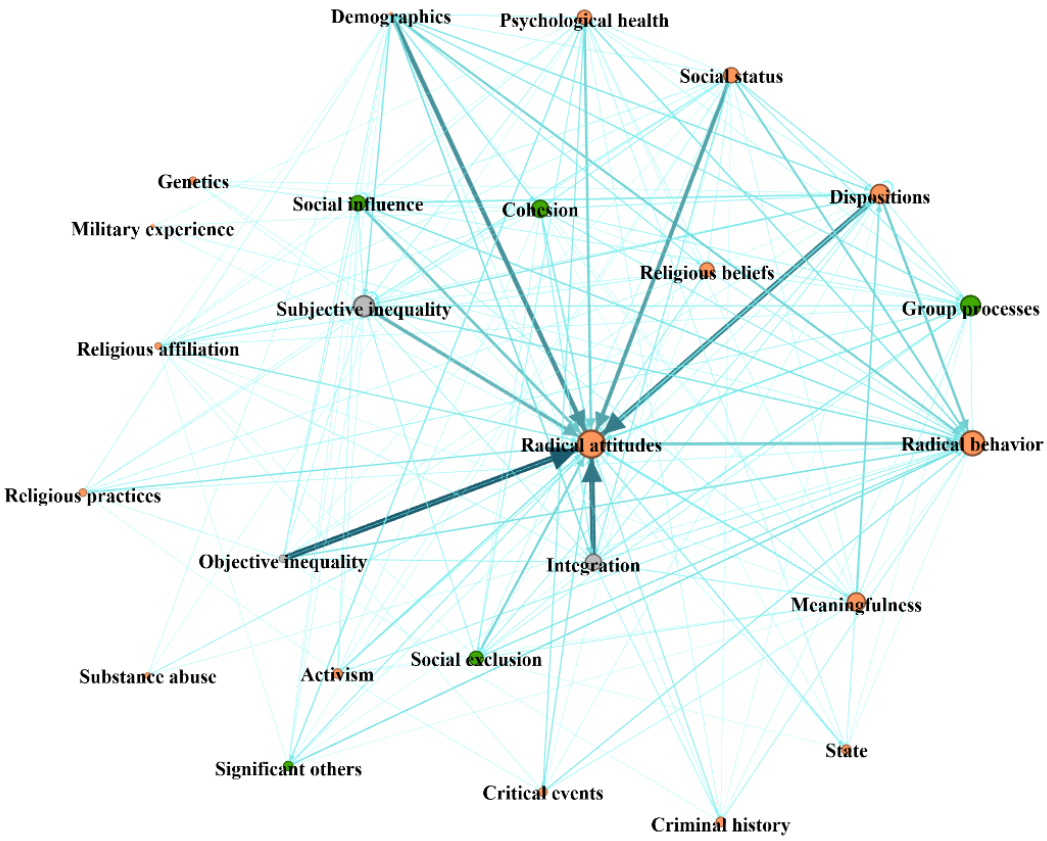

Figure 3: Network of hypotheses. Nodes represent constructs in hypotheses (node color: orange = micro-level construct, green = meso-level construct, gray = macro-level construct; width of edges is scaled to the occurrence frequency; node size is scaled to the respective node's in-degree centrality)

Overall results of the network analysis

Figure 3 shows the network of constructs and hypotheses illustrating the radicalization field. Overall, the research field reflects a substantially dense network (density = .407), implying a vast number of hypotheses and a lack of a parsimonious structure. Table 3 reports the associated network measures. Whereas the centrality measures reflect the number of hypotheses linking two constructs, their weighted forms consider the number of studies which had tested a referring hypothesis. In particular, the weighted in-degree centrality reflects the number of hypotheses expressing an effect *on* the respective construct weighted by the number of studies which had tested such a hypothesis.

Table 3
Network metrics based on constructs of self-reports, experimental, and trace data hypotheses

Construct	Close-ness centrality ($C(v)$)	In-degree centrality ($D^{+}(v)$)	Out-degree centrality ($D^{-}(v)$)	Weighted in-degree centrality	Weighted out-degree centrality	Betweenness centrality ($B(v)$)
Radical attitude	0.697	25	14	605	110	101.98
Radical behavior	0.418	22	1	275	3	0.00
Subjective inequality	0.697	18	14	98	116	24.28
Group processes	0.657	17	11	97	58	22.05
Dispositions	0.742	16	16	111	174	31.06
Meaningfulness	0.697	15	13	68	51	22.61
Cohesion	0.622	14	11	56	59	20.47
Integration	0.622	13	11	78	108	11.79
Social influence	0.657	12	13	59	96	15.88
Social status	0.852	12	19	24	146	44.95
Psychological health	0.742	11	15	23	107	62.38
Social exclusion	0.639	11	11	26	74	5.41
Religious beliefs	0.575	11	8	39	26	15.54
State	0.489	6	5	25	7	0.34
Activism	0.590	6	9	11	38	11.78

Significant others	0.548	6	6	22	32	0.16
Criminal history	0.469	6	4	10	24	0.22
Critical events	0.548	5	6	10	34	0.75
Objective inequality	0.605	4	10	10	119	6.29
Religious practices	0.500	4	5	10	30	0.34
Genetics	0.500	4	5	10	11	0.11
Religious affiliation	0.719	3	14	10	54	2.51
Substance abuse	0.434	2	2	10	9	0.00
Military experience	0.460	1	3	10	7	0.13
Demographics	0.800	0	18	10	195	0.00

In-degree centrality and out-degree centrality. As can be seen in Table 3, the construct considered most frequently was the presence of radical attitudes, which was considered as a central outcome of 25 antecedents and a determinant of 14 constructs. The most frequently considered determinants of radical attitudes, were objective inequality, subjective inequality, demographics, integration, social exclusion, social status, and dispositions. With regard to the overall number of expected incoming and outgoing effects, most relevant constructs were subjective inequality ($D^+(v)$ = 18, $D^-(v)$ = 14), group processes ($D^+(v)$ = 17, $D^-(v)$ = 11), dispositions ($D^+(v)$ = 16, $D^-(v)$= 16), meaningfulness ($D^+(v)$= 15, $D^-(v)$= 13). These constructs were assumed to be effective for other constructs as well as hypothesized as important outcomes.

Closeness centrality. With regard to the overall importance in the network (i.e., closeness centrality), social status (C_v = .852) and demographic characteristics (C_v= .800) were most central constructs, followed by dispositions (C_v = .742) and psychological health (C_v = .742): These constructs were directly related to a vast number of other constructs, indicating their role as central background variables to important outcomes.

Betweenness centrality. As aforementioned, constructs with a high betweenness centrality connect constructs in the field. These connections either represent a *mediating structure* (e.g., the target construct is hypothesized as a mediating mechanism between to other constructs), a *colliding structure* (i.e., the target construct is expected to have an

incoming effect by two other constructs), or the *confounder structure* (i.e., the target construct is supposed to act as a common cause of two other constructs). Whereas betweenness centrality represents the importance of a construct as a bridge builder, the weighted in-degree centrality and weighted out-degree centrality provides an impression about the assumed role of a certain construct. It should be noted, that a certain causal function of a construct is only conceivable with regard to a considered pair of constructs and that the following considerations represent a general evaluation of this function.

As Table 3 shows, radical attitude has the highest value of betweenness centrality ($B(v)$ = 101.98); both its high degree of in-degree centrality ($D^{+}(v)$ = 25) as well as its high level of out-degree centrality ($D^{-}(v)$ = 14) indicates that it represents the core hypothesized mediator in this field as it received a substantial number of effects and in turn emitted a substantial number (mainly towards radical behavior). The weighted forms of both centrality measures emphasize that this seems to be the focal perspective in the literature. Similarly, the betweenness centrality of psychological health was $B(v)$ = 62.38 and the latter had an almost equal number of in-degree and out-degree centrality thus signalling its potential as a mediator of certain pairs of variables and a collider or confounder of others. As stated earlier, the causal role of a construct always depends on the pair of target constructs. In our case, studies most frequently hypothesized it as a common cause—and, thus, confounder—of the relationship between radical attitude and radical behavior. One example is found in the study by Ellis, Bixby, Miller, and Sideridis (2016) in which anxiety and depression predicted sympathies for violent protest and terrorism, as well as delinquency. Social status ($B(v)$ = 44.95) functioned most frequently in a similar way as a confounder of the relationship between radical attitude and behavior (cf. Baier, Manzoni, & Bergmann, 2016, investigating the effect of school achievement on right-wing attitudes and behavior). Likewise, dispositions ($B(v)$ = 31.06) implied a confounder function in some studies (see Baier et al.'s, [2016] analysis of the effect of risk-seeking on left-wing attitudes and behaviour).

Analysis of approach-specific networks

Beyond the overall integration of studies in the field of radicalization, our paper strives to investigate differences across the applied research approaches. Table 4 shows the differences between the research approaches with regard to the number of studies which had measured a respective construct as well as the in-degree centrality and out-degree centrality. Further, we characterized each construct according to whether the differences in both centrality measures reflect a predominant perspective of the construct as a rather independent variable (i.e., determinant) or dependent variable (i.e., consequence) or both. We classified the role as independent versus dependent when the ratio between both exceeded 1.5.

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Table 4

Number of studies and network statistics across research approaches

	Survey research				Experimental research				Trace data research			
Construct	Number of studies (%)	In-degree centrality ($D^+(v)$)	Out-degree centrality ($D^-(v)$)	Prominent causal role	Number of studies (%)	In-degree centrality ($D^+(v)$)	Out-degree centrality ($D^-(v)$)	Prominent causal role	Number of studies (%)	In-degree centrality ($D^+(v)$)	Out-degree centrality ($D^-(v)$)	Prominent causal role
Radical attitude	27 (1.0)	22	10	Dependent	11 (.79)	12	3	Dependent	12 (.75)	15	7	Dependent
Group processes	10 (.37)	17	10	Mixed	2 (.14)	1	3	Independent	2 (.13)	0	2	Independent
Subjective inequality	18 (.67)	16	14	Mixed	3 (.21)	3	0	Dependent	5 (.31)	1	3	Independent
Military experience	0				0				5 (.31)	1	3	Independent
Radical behavior	8 (.30)	14	1	Dependent	3 (.21)	5	0	Dependent	8 (.50)	18	1	Dependent
Meaningfulness	7 (.26)	14	11	Mixed	4 (.29)	3	5	Mixed	1 (.06)	1	0	Mixed
Dispositions	13 (.48)	13	15	Mixed	8 (.57)	7	6	Mixed	5 (.31)	1	3	Independent
Psychological health	6 (.22)	10	3	Dependent	3 (.21)	1	5	Independent	4 (.25)	1	10	Independent
Religious beliefs	8 (.30)	10	7	Mixed	3 (.21)	2	2	Mixed	2 (.13)	0	1	Mixed
Social status	16 (.59)	10	18	Independent	0				7 (.44)	2	4	Independent
Social exclusion	11 (.41)	9	10	Mixed	2 (.14)	0	7	Independent	6 (.38)	2	2	Mixed
Integration	14 (.52)	13	11	Mixed	0				0			
Social influence	9 (.33)	10	12	Mixed	2 (.14)	0	3	Independent	6 (.38)	6	1	Dependent
Cohesion	6 (.22)	8	11	Mixed	4 (.29)	7	1	Dependent	9 (.56)	6	3	Dependent
Activism	1 (.04)	5	0	Dependent	3 (.21)	2	2	Mixed	3 (.19)	0	8	Independent
Criminal history	4 (.15)	5	3	Mixed	0				4 (.25)	1	1	Mixed

Significant others	3 (.11)	5	6	Mixed	0				5 (.31)	1	2	Independent
Genetics	1 (.04)	4	5	Independent								
Critical events	5 (.19)	3	4	Mixed	2 (.14)	0	4	Independent	5 (.31)	2	2	Mixed
Objective inequality	9 (.33)	3	9	Independent	0				3 (.19)	1	2	Independent
Religious affiliation	7 (.26)	3	13	Independent	0				1 (.06)	0	1	Independent
Religious practices	5 (.19)	3	5	Mixed	0				3 (.19)	1	2	Independent
Substance abuse	2 (.07)	1	1	Mixed	0				2 (.13)	1	1	Mixed
Demographics	15 (.56)	0	18	Independent	1 (.07)	0	4	Independent	6 (.38)	0	3	Independent
State	1 (.04)	0	1	Independent	8 (.57)	6	4	Mixed	1 (.06)	1	0	Mixed

Note. Number in parentheses are proportions of studies within the respective approach

As Table 4 shows that there are some differences between the approaches. *First*, and not surprisingly, all approaches focused on radical attitudes to a comparable degree. In contrast, the focus on the radical behavior itself was highest in trace data research, probably due to the focus of open source studies on coded behavioral data such as Profiles of Individual Radicalization in the United States (PIRUS). *Second*, and according to our expectations, dispositions were most frequently investigated in survey studies and experimental studies, probably due to the ease of measuring respective constructs with questionnaires. The same result and interpretation holds for meaningfulness, but interestingly not for other constructs that indicate some kind of reflection or subjective assessment (e.g., psychological health, religious beliefs) which were investigated comparably often in the three approaches. A substantial contrast is the number of survey studies focusing on integration (50 %) and subjective inequality (67 %).

With regard to the presumed causal role of the constructs, most constructs were regarded as determinants as well as consequences of other constructs. The percentage of these "mixed roles," however, varied across the approaches: Whereas 14 of the 25 constructs were hypothesized as independent as well as dependent, this was only the case for five constructs in experimental research and six constructs in trace data research. It should be noted that these results do not imply a state ambiguity or arbitrariness, but rather reflect a potential role of several constructs as more or less explicit mediating variables.

Discussion

This systematic review intended to illustrate, summarize, and integrate the research focusing on determinants and outcomes of radicalization constructs. To this end, we applied an innovative network approach to graphically represent radicalization research and to statistically analyze the role, prevalence, and centrality of the constructs and hypotheses. Moreover, we investigated how the perspectives and focused constructs vary across research approach.

Lack of parsimony in the research field

The most striking result was the quantity of constructs investigated over the years and even our aggregation procedures still resulted in 25 higher-order constructs located on the individual level, group level, or societal level. The results from the network analysis further revealed a substantially dense structure, indicating a lack of parsimony of the field (see also Wolfowicz et al., 2019).

One part of the explanation may lie in the historic development of the research on radicalization, starting with the focus on surface-level demographic constructs (e.g. age or gender) and psychological health in order to identify radical individuals (cf. Stern, 2016). Further research efforts moved to disentangle the specificity problem (cf. Sageman, 2014) namely, why only some individuals out of the population confronted with the same determinants (e.g., discrimination experiences), in fact radicalize. This in turn may reflect a variety of further determinants considered in research to address particularly the lack of specificity for attitudinal extremism (cf. Slootman & Tillie, 2006). However, when partitioning the network according to the publication year of the study and comparing post-hoc the two resultant subnetworks (2014-2019 and 2005-2013) both density values did not yield substantive differences, which might speak against the historic explanation of the lack of parsimony.

A further explanation may be potential differences in the predictors of the different extremism ideologies (e.g., right-wing extremism vs. religious extremism), which might account for the heterogeneity of determinants and thereby network patterns. The apparent fragmentation additionally increased as other research approaches such as experimental research and trace data research developed and added contributions to the literature.

As an example, scholars have traditionally assumed that “social influence” is a major determinant of radicalization. While historically, social influence rather referred to the influence of peers or traditional media, technical developments of other media sources (e.g., the Internet and social media) were integrated in the overall concept of social influence (see Taylor et al., 2015), which represented the assumption that the development of radical

attitudes is a direct consequence of contacts with extremist social media content. Apart from the increased broadness of the overall social influence concept, the review by Odag, Leiser, and Boehnke (2019) raised doubts on this assumption as the literature lacks sufficient investigations that could explain the link between media effect and constructs of radicalization.

While it is beyond the scope of this systematic review to recommend any particular framework, one basic approach to understand an individual's broader motivation-set would be to organize constructs in the multilevel framework on which our coding was based (cf. Schmid, 2013). Consequently, as a next principle, organizing constructs on a continuum ranging from distal or broad (demographic, personality, societal), over proximal or more radicalization focused (e.g., group processes, cohesion, experiences) to radical attitudes and behavior, reflects the interplay of circumstances, beliefs, attitudes and behavior (cf. the reasoned-action approach, Fishbein & Ajzen, 2010). This is as well reflected in the general meaning framework by Kruglanski and colleagues (2014) in which the individual's quest for significance is a major motivational driver for violent extremism. Especially the need for restoration of a sense of purpose and meaning in interaction with societal processes, alongside group dynamics through which the individual comes to share violent ideology and narratives might lead to different degrees of radicalization (ranging from passive support to self-sacrifice).

Evaluation of the results

Coercing study-specific constructs to higher-order constructs faces a trade-off between parsimony and precision. In particular, reducing the number of the myriads of "bloated specifics" (Cattell, 1978) into organized, and integrated higher-order constructs achieves parsimony of constructs, as it enables to identify generic principles inherent in radicalization research, across extremism types. The approach presented is an economic representation of an etiological network, linking causes and effects and allows to clarify and represent domain knowledge inferred from hypotheses.

One example for a broad construct in our network are dispositions. Decomposing dispositions into their lower-level constructs revealed the prominence of constructs like authoritarianism or low self-control (impulsivity and risk-seeking). For instance, studies showed that authoritarian individuals tend to hold antidemocratic social attitudes, are rigidly attached to traditional values, uncritically accept authorities and are intolerant toward opposing views. Authoritarianism was frequently hypothesized to predict psychological uncertainty or willingness to engage in extreme means (Rieger, Frischlich, & Bente, 2017). The results of our network analysis can be integrated with prior research. In their meta-analysis, Wolfowicz et al. (2019), identified risk and protective factors for different outcomes of radicalization and presented a rank-order of these factors according to their effect sizes, in which authoritarianism had a relatively large effect (ibid.).

Similarly, when contextualizing the high closeness centrality of dispositions and thus importance in the network, self-control emerged as an important construct. The role of low self-control for radical behaviour was also found to have a relatively large effect in the meta-analysis by Wolfowicz et al. (2019). These factors have also been investigated by Pauwels and Svensson (2017) who found an interaction between the degree of extremist beliefs and self-control in reducing the propensity for radical behaviour. Finally, constructs like integration, demographics, or peers and religion emerged as prominent foci of prior research. Our review found that the integration construct (with an out-degree centrality, $D^{-}(v) = 11$) figured in the network as antecedent for radical attitudes, cohesion, as well as group processes (see Coid et al., 2016; Ellis et al., 2015; Simon, Reichert, & Grabow, 2013). Again, our findings can be contextualized by those found by Wolfowicz et al. (2019) and their critical discussion on the role of low integration as a risk factor for radicalization, for which they found modest effects for radical intentions and behaviour. Furthermore, higher-order constructs such as demographics (out-degree centrality, $D^{-}(v) = 18$) were frequently hypothesized. Similarly, Wolfowicz et al. (2019) found these to be among the most commonly examined factors, albeit displaying small and sometimes non-significant effect sizes on radical attitudes and behaviors. In contrast, their analysis found that radical peers was

important risk factors for radical attitudes and behaviours. But this also connects to the central point of the network that multiple constructs reaching from individual to social levels play into the connection of radical attitudes and radical behaviors which in turn have been most prevalent in the network. In this regard, Wolfowicz and colleagues (2019) argued there are both arguments for and against a risk effect of religious beliefs and practices in the radicalization process. They showed on the one hand small effects on the radical attitude whereas on the other hand the importance of the identification with the group was shown to be more important (ibid.).

By forming higher-order dispositional constructs, we illustrate that *adversarial personality traits* (low self-control), traits implying an *identity-weakness* (low self-esteem), *opportunities for engagement* (salient injustice narratives that imply dissatisfaction with the "system" and blames on the outgroup and threats) and *anxiety-related traits* (uncertainty-aversion, need for structure) may prompt an engagement in radical groups or radical attitudes (see also McGregor, Hayes, & Prentice, 2015).

With regard to the comparison of the research approaches, our results demonstrated the dominance of survey research and a comparably lower number of trace data studies. This is disadvantageous, as trace data allows researchers to measure behavior in its naturally occurring social context (i.e., social media, see Batzdorfer, Steinmetz, & Bosnjak, 2020).

However, the sole focus on Twitter in this context has been criticized by Parekh, Amarasingam, Dawson, and Ruths (2018). Lesser known platforms (such as 4chan) have yet to be sufficiently considered in terms of their relevance and reach for the radicalization process (Schmid & Forest, 2018). In view of the intensive linkage and interaction of social networks (cf. Johnson et al., 2019), a holistic view across platforms is lacking, as is an answer to the question of whether determinants and conducive framework conditions that have been analyzed on one particular platform can be generalized to others. This is of relevance, especially since mainly verbal behavior can be observed on Twitter, while other platforms are more strongly characterized by visual elements (e.g., so-called "memes", i.e., quickly spreading images with verbal expressions) (Munn, 2019). Other platforms, such as the

"4chan," are strongly characterized by anonymity, irony, and acronyms and cannot be quantified with classical text mining approaches. The latter illustrates new challenges in the evaluation and transferability of previous theoretical assumptions to these milieus. While questionnaire studies are often criticized for the risk of bias due to measurement errors and desirability trends, digital behavioral trace data analysis also faces measurement problems: While demographic characteristics can easily be extracted, the extraction of contextual data (e.g., number of retweets, number of friends) and user-generated content (e.g., text content, “likes” of other users' statements, self-reported individual differences) must be done with respect to the target construct, taking into account the context in which the behavioral trajectories were created when interpreting them (see Landers, Brusso, Cavanaugh, & Collmus, 2016). In order for digital behavioral trajectory data analyses to have a relevant impact on theoretical models, it is essential to integrate them into a "data or measurement theory" that conceptualizes behavior as a product of the interaction between person and situation (cf. Landers et al., 2016). When sampling from a social graph like Twitter, the context in which social media data are collected (e.g., platform characteristics or proprietorial algorithms) impacts the quality of the data obtained and henceforward, the quality and validity of the insights gained from these analyses. Whereas traditional behavioral sciences have emphasized the role of measurement models or theories that connect data with supposed theoretically important entities, this is seldom the case in social media research. Hence it is crucial that researchers formulate such models and explicate theoretical links (i.e., causally or logically) between measured data and referring constructs. One further route can be to seek multiple indicators for the same construct under investigation, as some indicators might be more closely related to each other than taken in isolation.

Finally, digital behavioral trace data analyses offer an approach to understand radicalization, which is caused by determinants that partly stem from the biographical course of development (e.g., experienced deprivation). While this is a clear causal focus, existing studies are based almost exclusively on cross-sectional approaches. With the newly emerging possibilities offered by digital behavioral trace data, the focus should be on the integration of

traditional approaches and new technologies to map the process character. As an example, approaches such as online field experiments on the dissemination of emotional states in social networks, as already implemented by Kramer, Guillory, and Hancock, (2014), could provide new insights into the milieu and have heuristic significance and explanatory value.

A stricter focus on causal identification

The main strength of applying a network theoretical approach is that the network summarizes the more or less explicit causal hypotheses in the field and the resulting role of the constructs within the causal structure. As the network analysis indicated, some constructs were uniformly hypothesized as mediators (e.g., radical attitudes) whereas most constructs were most often expected to be causes as well as outcomes, implying their potential role as confounders (i.e., variables affecting two or more other target constructs) or colliders (i.e., variables which are outcomes of two or more target constructs). While the experimental research reviewed in this paper has the immense strength of enhancing causal interpretability due to the randomization of the hypothetical construct, survey research and studies relying on trace data are naturally much more plagued by biases resulting from the observational data. While this state of affairs has resulted in a resignation and problematic jargon, avoiding causal concepts and using rather imprecise "relationship" rhetoric (cf. Pearl & MacKenzie, 2018), our study provides a basis for improving statistical models in order to reduce causal biases (see also Antonakis, Bendahan, Jacquart, & Lalive, 2010) by the following means:

First, considering potential confounders of a targeted relationship provides a basis for controlling for relevant variables. The list of higher-order constructs and those constructs contained in the primary studies (see Table 2) provide a checklist of constructs which could be considered as potential confounders for a particular relationship (as practical examples, see the studies by Shrier, & Platt, 2008; or Vahratian, Siega-Riz, Savitz, & Zhang, 2005; or the theoretical basis in Vanderweele, 2019).

Second, colliders are less known to the field but represent an equally valid threat to causal inference (Elwert, 2013; Pearl, 2009; Rohrer, 2018), especially when it comes to the

question of which variable a researcher should control and which should s/he not control. In this regard, controlling for colliders will introduce a bias in the estimate of the effect. As a simple rule and with reference to the graph in Figure 2, we recommend not to control for a variable that likely receives an arrow from the hypothetical exogenous variable as this will either represent a collider or a mediator (Pearl, Glymour, & Jewell, 2016; Rohrer, 2018). An alternative form of collider bias is endogenous selection bias, which emerges when a subgroup is drawn on the basis of a dependent variable (Elwert & Winship, 2014). For instance, focusing on a subsample of persons with a radical attitude may induce a bias on potential effects of a model with radical attitude as a mediator or outcome. Again, as a simple rule, we would recommend not to select a subsample based on a variable that is a dependent variable in the considered model. As before, the network analysis and the list of constructs may provide a basis for deciding which relevant variables the considered model may contain.

Limitations of the present study

While we stress the contributions of our study, we see three aspects that could cause some scepticism. First, we focused on the networks of proposed hypotheses instead of actual results, which probably would have resulted in a sparser network. However, this approach perfectly represents our main goal—to summarize the theoretical perspectives in the field. Although estimating a network with empirical effect sizes is attractive, such an approach would have run into difficulties as the relationships between constructs substantially vary in the number of studies on which they are based (Cheung & Chan, 2005) resulting in ambiguity about the relevant sample size necessary for statistical tests. While this problem has been solved in confirmatory approaches to meta-analytical structural equation models (i.e., a multivariate extension of meta-analysis, see Viswesvaran & Ones, 1995), it is still an open problem in exploratory approaches (such as networks or causal search algorithms, see Glymour, 2004). At the same time, our results and their discussion may guide the selection and incorporation of central constructs into a future meta-analytical model.

Second, our comparison of the research approaches was qualitative and subjective. As the network structures were not nested, application of inferential statistics was not possible, resulting in perhaps spurious differences. Third, and related to this issue is the fact that research approaches did not only vary in the constructs but also in the populations that provided the data. Studies substantially differed with regard to whether they were based on a clear conceptualization of a population at all (vs. using ad-hoc samples) or whether they applied some systematic sampling process (vs. selecting a sub-group of individuals based on some characteristic). Analogous to our plea for using integrative theoretical frameworks more, we would recommend to more clearly conceptualize a referent population and to at least attempt to approach ideal forms of sampling in contrast to selecting individuals either ad-hoc or based on some characteristics. Our discussion on potential endogenous selection biases provided a theoretical basis based on a graph to consider the circumstances where this is appropriate versus problematic.

Conclusion

In the present systematic review, we applied an innovative network theoretical approach to synthesize the hypotheses in a research field. By these means, our analyses provide a snapshot of the collective thoughts on determinants and outcomes within the radicalization context of a whole community of researchers. As the contribution intended, we hope to have delivered some basis on what the community focuses on, its hypotheses and assumptions, as well as differences and similarities between the various approaches. The results give an impression about a field developed by integrating vastly different perspectives, constructs, and assumptions, and they clearly indicate that the time is rife for their integration.

References

Ajzen, I. (2005). *Attitudes, personality and behavior*. Milton-Keynes, England: Open University Press.

Antonakis, J., Bendahan, S., Jacquart, P., & Lalive, R. (2010). On making causal claims: A review and recommendations. *The Leadership Quarterly*, 21, 1086-1120. doi:10.1016/j.leaqua.2010.10.010

Baier, D., Manzoni, P., & Bergmann, M. C. (2016). Einflussfaktoren des politischen Extremismus im Jugendalter. Rechtsextremismus, Linksextremismus und islamischer Extremismus im Vergleich. *Monatsschrift für Kriminologie und Strafrechtsreform*, *99*(5), 171-198.

Batzdorfer, V., Steinmetz, H., & Bosnjak, M. (2020). Big Data in der Radikalisierungsforschung: Eine systematische Übersichtsarbeit. [Big Data in radicalization research: A systematic review]. *Psychologische Rundschau*, *71*(2), 96-102.

Bavelas, A. (1950). Communication patterns in task-oriented groups. *The Journal of the Acoustical Society of America*, *22*(6), 725-730.

Bhui, K., Otis, M., Silva, M. J., Halvorsrud, K., Freestone, M., & Jones, E. (2019). Extremism and common mental illness: Cross-sectional community survey of White British and Pakistani men and women living in England. *The British Journal of Psychiatry*, 1-8.

Borgatti, S. P., Mehra, A., Brass, D. J., & Labianca, G. (2009). Network analysis in the social sciences. *Science*, *323*(5916), 892-895. doi:10.1126/science.1165821.

Borsboom, D., & Cramer, A. O. J. (2013). Network analysis: An integrative approach to the structure of psychopathology. *Annual Review of Clinical Psychology*, *9*(1), 91-121. doi:10.1146/annurev-clinpsy-050212-185608.

Borum, R. (2011). Radicalization into violent extremism I: A review of social science theories. *Journal of strategic security*, *4*(4), 7-36.

Burt, R. (2000). The network structure of social capital. *Research in Organizational Behavior*, 22, 345-423.

Cattell, R. B. (1978). The Scientific Use of Factor Analysis in Behavioral and Life Sciences, Plenum, New York.

Christmann, K. (2012). *Preventing religious radicalisation and violent extremism: A systematic review of the research evidence*. Research Report. Youth Justice Board.

Cheung, M. W. L., & Chan, W. (2005). Meta-analytic structural equation modeling: A two-stage approach. *Psychological Methods, 10*(1), 40-64.

Constantini, G., Richetin, J., Borsboom, D., Fried, E. I., Rhemtulla, M., & Perugini, M. (2015). Development of indirect measures of conscientiousness: Combining a facets approach and network analysis. *European Journal of Personality*, 29(5), 548-567.

Coid, J. W., Bhui, K., MacManus, D., Kallis, C., Bebbington, P., & Ullrich, S. (2016). Extremism, religion and psychiatric morbidity in a population-based sample of young men. *The British Journal of Psychiatry*, *209*(6), 491-497.

Cooper, H. (2017). *Research synthesis and meta-analysis: A step-by-step approach* (Fifth ed.). Los Angeles, CA, USA: Sage.

Corner, E., & Gill, P. (2015). A false dichotomy? Mental illness and lone-actor terrorism. *Law and Human Behavior*, *39*(1), 23-34. http://dx.doi.org/10.1037/lhb0000102

Dechesne, M. (2009). Explorations in the experimental social psychology of terrorism: The struggle-violence link and its predictors. *Revue Internationale de Psychologie Sociale*, *22*(3-4), 87-102.

Desmarais, S. L., Simons-Rudolph, J., Brugh, C. S., Schilling, E., & Hoggan, C. (2017). The state of scientific knowledge regarding factors associated with terrorism. *Journal of Threat Assessment and Management*, *4*(4), 180.

Doosje, B., Loseman, A., & Van den Bos, K. (2013). Determinants of radicalization of Islamic youth in the Netherlands: Personal uncertainty, perceived injustice, and perceived group threat. *Journal of Social Issues*, *69*(3), 586-604.

Egan, V., Cole, J., Cole, B., Alison, L., Alison, E., Waring, S., & Elntib, S. (2016). Can you identify violent extremists using a screening checklist and open-source intelligence alone? *Journal of Threat Assessment and Management*, *3*(1), 21-36.

Ellis, B. H., Bixby, C., Miller, A., & Sideridis, G. (2016). *Understanding pathways to and away from violent radicalization among resettled Somali refugees*. Boston: Boston Children's Hospital.

Elwert, F. (2013). Graphical causal models. In S. L. Morgan (Ed.), *Handbook of causal analysis for social research*. (pp. 245-273). Dordrecht Heidelberg New York London: Springer.

Elwert, F., & Winship, C. (2014). Endogenous selection bias: The problem of conditioning on a collider variable. *Annual Review of Sociology, 40*, 31-53. doi:10.1146/annurev-soc-071913-043455.

Fishbein, M., & Ajzen, I. (2010). *Predicting and changing behavior: The reasoned action approach*. New York: Taylor & Francis.

Franc, R., & Pavlović, T. (2018). Systematic review of quantitative studies on inequality and radicalisation. DARE (725349).

Frischlich, L., Rieger, D., Hein, M., & Bente, G. (2015). Dying the right-way? Interest in and perceived persuasiveness of parochial extremist propaganda increases after mortality salience. *Frontiers in Psychology*, 6, 1222.

Glymour, C. (2004). The automation of discovery. *Daedalus, 133*(1), 69-77. doi:10.1162/001152604772746710

Grossman, M., & Tahiri, H. (2015). Community perceptions of radicalisation and violent extremism: An Australian perspective. *Journal of Policing, Intelligence and Counter Terrorism, 10*(1), 14-24.

Hassan, G., Brouillette-Alarie, S., Alava, S., Frau-Meigs, D., Lavoie, L., Fetiu, A., ... & Sieckelinck, S. (2018). Exposure to extremist online content could lead to violent radicalization: A systematic review of empirical evidence. *International Journal of Developmental Science*, *12*(1-2), 71-88.

Horgan, J. (2008). From profiles to pathways and roots to routes: Perspectives from psychology on radicalization into terrorism. *The ANNALS of the American Academy of Political and Social Science, 618*(1), 80-94.

Johnson, N. F., Leahy, R., Restrepo, N. J., Velasquez, N., Zheng, M., Manrique, P., ... & Wuchty, S. (2019). Hidden resilience and adaptive dynamics of the global online hate ecology. *Nature*, *573*(7773), 261-265.

Kerodal, A. G., Freilich, J. D., & Chermak, S. M. (2016). Commitment to extremist ideology: Using factor analysis to move beyond binary measures of extremism. *Studies in Conflict & Terrorism*, *39*(7-8), 687-711.

Klausen, J., Campion, S., Needle, N., Nguyen, G., & Libretti, R. (2016). Toward a behavioral model of "homegrown" radicalization trajectories. *Studies in Conflict & Terrorism*, *39*(1), 67-83.

Kramer, A. D., Guillory, J. E., & Hancock, J. T. (2014). Experimental evidence of massive-scale emotional contagion through social networks. *Proceedings of the National Academy of Sciences*, *111*(24), 8788-8790.

Kruglanski, A. W., Gelfand, M. J., Bélanger, J. J., Sheveland, A., Hetiarachchi, M., & Gunaratna, R. (2014). The psychology of radicalization and deradicalization: How significance quest impacts violent extremism. *Political Psychology*, 35, 69-93.

LaFree, G., Jensen, M. A., James, P. A., & Safer-Lichtenstein, A. (2018). Correlates of violent political extremism in the United States. *Criminology*, *56*(2), 233-268.

Landers, R. N., Brusso, R. C., Cavanaugh, K. J., & Collmus, A. B. (2016). A primer on theory-driven web scraping: Automatic extraction of big data from the Internet for use in psychological research. *Psychological Methods*, *21*(4), 475-492. https://doi.org/10.1037/met0000081

Lösel, F., King, S., Bender, D., & Jugl, I. (2018). Protective factors against extremism and violent radicalization: A systematic review of research. *International Journal of Developmental Science*, *12*(1-2), 89-102.

Loza, W. (2011). The prevalence of the Middle-Eastern extreme ideologies among some Canadians. *Journal of Interpersonal Violence*, *26*(7), 1388-1400.

McCauley, C., & Moskalenko, S. (2017). Understanding political radicalization: The two-pyramids model. *American Psychologist*, *72*(3), 205.

McGlashan, J., Johnstone, M., Creighton, D., de la Haye, K., & Allender, S. (2016). Quantifying a systems map: Network analysis of a childhood obesity causal loop diagram. *Plos One*, *11*(10).

McGregor, I., Hayes, J., & Prentice, M. (2015). Motivation for aggressive religious radicalization: Goal regulation theory and a personality× threat× affordance hypothesis. *Frontiers in Psychology*, *6*(1325), 1-18.

MacKinnon, D. P., Fairchild, A. J., & Fritz, M. (2007). Mediation analysis. *Annual Review of Psychology*, 58, 593-614.

McGilloway, A., Ghosh, P., & Bhui, K. (2015). A systematic review of pathways to and processes associated with radicalization and extremism amongst Muslims in Western societies. *International review of psychiatry*, *27*(1), 39-50.

Mitts, T. (2019). From isolation to radicalization: Anti-Muslim hostility and support for ISIS in the West. *American Political Science Review*, *113*(1), 173-194.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., Altman, D., Antes, G., ... & Clark, J. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement (Chinese edition). *Journal of Chinese Integrative Medicine*, *7*(9), 889-896.

Munn, L. (2019). Alt-right pipeline: Individual journeys to extremism online. *First Monday*, *24*(6).

Neumann, P., & Kleinmann, S. (2013). How rigorous is radicalization research? *Democracy and Security*, *9*(4), 360-382.

Odag, Ö., Leiser, A., & Boehnke, K. (2019). Reviewing the role of the Internet in radicalization processes. *Journal for Deradicalization*, *21*, 261-300.

Opp, K. D. (2019). *Analytical Criminology. Integrating Explanations of Crime and Deviant Behavior*. Routledge.

Opp, K.-D., & Wippler, R. (Eds.) (1990). *Empirischer Theorienvergleich. Erklärungen sozialen Verhaltens in Problemsituationen.* [Empirical comparison of theories. Explanations of social behaviour in problem situations] Opladen: Westdeutscher Verlag.

Ozer, S., & Bertelsen, P. (2018). Capturing violent radicalization: Developing and validating scales measuring central aspects of radicalization. *Scandinavian Journal of Psychology*, *59*(6), 653-660.

Pape, R.A. (2009) Introduction: What is new about research on terrorism. *Security Studies*, *18*(4), 643-650. https://doi.org/10.1080/09636410903369100.

Parekh, D., Amarasingam, A., Dawson, L., & Ruths, D. (2018). Studying jihadists on social media: A critique of data collection methodologies. *Perspectives on Terrorism*, *12*(3), 5-23.

Pauwels, L., & Schils, N. (2016). Differential online exposure to extremist content and political violence: Testing the relative strength of social learning and competing perspectives. *Terrorism and Political Violence*, *28*(1), 1-29.

Pauwels, L. J., & Svensson, R. (2017). How robust is the moderating effect of extremist beliefs on the relationship between self-control and violent extremism?. *Crime & Delinquency*, *63*(8), 1000-1016.

Pawson, R. (2006). *Evidence-based policy: A realist perspective.* Sage.

Pearl, J. (2009). *Causality: Models, reasoning, and inference*. New York: Cambridge University Press.

Pearl, J., Glymour, C., & Jewell, N. P. (2016). *Causal inference in statistics: A primer*: Wiley.

Pearl, J., & MacKenzie, D. (2018). *The book of why*. New York: Basic Books.

Pelzer, R. (2018). Policing of terrorism using data from social media. *European Journal for Security Research*, *3*(2), 163-179. http://doi.org/10.1007/s41125-018-0029-9

Pretus, C., Hamid, N., Sheikh, H., Ginges, J., Tobeña, A., Davis, R., ... & Atran, S. (2018). Neural and behavioral correlates of sacred values and vulnerability to violent extremism. *Frontiers in Psychology*.

R Core Team (2018). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Available online at https://www.R-project.org/.

Rieger, D., Frischlich, L., & Bente, G. (2017). Propaganda in an insecure, unstructured world: How psychological uncertainty and authoritarian attitudes shape the evaluation of right-wing extremist internet propaganda. *Journal of Deradicalization*, 10, 203-229.

Rohrer, J. M. (2018). Thinking clearly about correlations and causation: Graphical causal models for observational data. Advances in methods and practices in psychological science, *1*(1), 27-42. doi:10.1177/2515245917745629

Rowe, M., & Saif, H. (2016). Mining pro-ISIS radicalisation signals from social media users. In Tenth International AAAI Conference on Web and Social Media.

Sackett D., Rosenberg, W., Gray, J., Haynes, R., &, Richardson, WS. (1996). Evidence-based medicine: What it is and what it isn't. *British Medical Journal*, 312(7023):71–72.

Sageman, M. (2014). The stagnation in terrorism research. *Terrorism and Political Violence*, *26*(4), 565-580.

Scarcella, A., Page, R., & Furtado, V. (2016). Terrorism, radicalisation, extremism, authoritarianism and fundamentalism: A systematic review of the quality and psychometric properties of assessments. *PloS one*, *11*(12).

Schmid, A. P. (2013). Radicalisation, de-radicalisation, counterradicalisation: A conceptual discussion and literature review. *ICCT Research Paper*, *97*(1).

Schmid, A. P., & Forest, J. J. (2018). Research desiderata: 150 un- and under-researched topics and themes in the field of (counter-) terrorism studies–a new list. *Perspectives on terrorism*, *12*(4), 68-76.

Shrier, I., & Platt, R. W. (2008). Reducing bias through directed acyclic graphs. *BMC Medical Research Methodology*, *8*(1), 70. https://doi.org/10.1186/1471-2288-8-70

Simon, B., Reichert, F., & Grabow, O. (2013). When dual identity becomes a liability: Identity and political radicalism among migrants. *Psychological Science, 24*(3), 251-257.

Slootman, M., & Tillie, J. (2006). Processes of radicalisation. *Why some Amsterdam Muslims become radicals. Amsterdam: Institute for Migrations and Ethnic Studies, University of Amsterdam*, Amsterdam, 1-129.

Stern, J. (2016). Radicalization to extremism and mobilization to violence: What have we learned and what can we do about it? *The ANNALS of the American Academy of Political and Social Science, 668*(1), 102-117.

Sweeney, M. M., & Perliger, A. (2018). Explaining the spontaneous nature of far-right violence in the United States. *Perspectives on Terrorism, 12*(6), 52-71.

Taylor, W. D., Johnson, G., Ault, M. K., Griffith, J. A., Rozzell, B., Connelly, S., ... & Ness, A. M. (2015). Ideological group persuasion: A within-person study of how violence, interactivity, and credibility features influence online persuasion. *Computers in Human Behavior, 51*, 448-460.

Tranfield, D., Denyer, D., & Palminder, S. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British Journal of Management*, 14, 207-222.

Vanderweele, T. J. (2019). Principles of confounder selection. *European Journal of Epidemiology*, 3, 211-219. doi:10.1007/s10654-019-00494-6

Van De Wijngaert, L., Bouwman, H., & Contractor, N. (2014). A network approach toward literature review. *Quality & Quantity*, *48*(2), 623-643.

Vahratian, A., Siega-Riz, A. M., Savitz, D. A., & Zhang, J. (2005). Maternal pre-pregnancy overweight and obesity and the risk of caesarean delivery in nulliparous women. *Annals of Epidemiology*, *15*(7), 467-474. doi:10.1016/j.annepidem.2005.02.005

Vergani, M., Iqbal, M., Ilbahar, E., & Barton, G. (2018). The three Ps of radicalization: Push, pull and personal. A systematic scoping review of the scientific evidence about radicalization into violent extremism. *Studies in Conflict & Terrorism*, 1-32.

Viswesvaran, C., & Ones, D. S. (1995). Theory testing: Combining psychometric meta-analysis and structural equations modeling. *Personnel Psychology, 48*, 865-885.

Wasserman, S., & Faust, K. (1994). *Social network analysis: Methods and applications* (Vol. 8): Cambridge University Press.

Wibisono, S., Louis, W. R., & Jetten, J. (2019). A Multi-Dimensional Analysis of Religious Extremism. *Frontiers in Psychology*, 10, 2560. doi: 10.3389/fpsyg.2019.02560

Wolfowicz, M., Litmanovitz, Y., Weisburd, D., & Hasisi, B. (2019). A field-wide systematic review and meta-analysis of putative risk and protective factors for radicalization outcomes. *Journal of Quantitative Criminology*, 1-41.

Zhirkov, K., Verkuyten, M., & Weesie, J. (2014). Perceptions of world politics and support for terrorism among Muslims: Evidence from Muslim countries and Western Europe. *Conflict Management and Peace Science, 31*(5), 481-501.

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Appendix A: Results from Database Search

Database/Resource	Host	Search Dates	Date Searched (DD.MM.YY)	Results
PubPsych	https://pubpsych.zpid.de/pubpsych/	2005-current	April 12, 2019	1,337
Medline (ALL)	OVID	1946 to April 10, 2019 (search limited 2005-current)	April 11, 2019	1,112
PsycINFO	OVID	2002 to April Week 1 2019 (search limited 2005-current)	April 11, 2019	2,456
ISI Web of Knowledge Science Citation Index	Web of Science	1988-2019.04.12 (search limited 2005-current)	April 12, 2019	986
Social Science Research Network (SSRN)	https://www.ssrn.com/index.cfm/en/	2005-current	April 12, 2019	341
dblp	https://dblp.uni-trier.de/	2005-current	April 12, 2019	263
IEEE Xplore	https://ieeexplore.ieee.org/search/advsearch.jsp	2005-current	April 12, 2019	586
ACM Digital Library	https://dl.acm.org/advsearch.cfm	2005-current	April 12, 2019	192
JSTOR	https://www.jstor.org/action/showAdvancedSearch	2005-current	April 17, 2019	275
The Campbell Library	https://www.campbellcollaboration.org/library.html	2005-current	May 03, 2018	4

Database/Resource	Host	Search Dates	Date Searched (DD.MM.YY)	Results
National Criminal Justice Reference Service Abstracts (NCJRS)	https://www.ncjrs.gov/App/AbstractDB/AbstractDBSearch.aspx	2005-current	May 03, 2018	69
			Total retrieved	7,621
			Duplicates removed	1,080
			Total to screen	6,541

Appendix B: Brief Definition of Centrality Measures

Technically, a *graph* $G = (V, E)$ consists of a set of *vertices* V (nodes) and a set of *edges* E. Nodes represent objects and are represented by a set of unique nodes ($\{v1, v2, v3, v4, \ldots, v_n\}$). Edges $e \in E$ are associated with sets of pairs of nodes (i.e., $e = \{u, v\}$). If a graph G has an ordering to its nodes (i.e., so that $\{u, v\}$ is distinct from $\{v, u\}$, for $u, v \in V$) then it is a directed graph where u is the source and v the target ($u \rightarrow v$).

Structural metrics to summarize the entire graph on radicalization research in this study comprise the in-degree and out-degree centrality, closeness centrality, betweenness centrality, and network density. Concerning the degree centrality, in-degree accounts for the number of incoming ties to a node v and is usually denoted by $D^+(v)$ whereas, outgoing edges are $D^-(v)$. Closeness centrality C_v expresses the overall position of a node in the network. It is represented by the average length of the shortest path between the node v and all other nodes in the graph. A common metric to denote the number of shortest paths σ_{sd} between nodes s and d is the node betweenness $B(v)$. Further, $\sigma_{sd}(v)$ represents the number of shortest paths which pass through the node v. Density ρ is a network-level measure that explains general level connectedness, where $m(G)$ is the total number of edges in the network G and $m_{max}(G)$ denotes the number of possible edges in the network (i. e., $n(n-1)$).

Appendix C: Search Strategies

PsycINFO:
1 exp terrorism/ (7028)
2 extremism/ or religious fundamentalism/ (765)
3 (Radicali* or extremist* or extremism or terrori* or (political adj2 violen*) or (radical* adj2 religio*) or fundamentalism or fundamentalist*).ti,ab,tw. (11465)
4 or/1-3 (12745)
5 (clinical case stud* or clinical trial* or empirical stud* or experimental replication or followup stud* or longitudinal stud* or meta analys?s or metasynthesis or prospective stud* or quantitative stud* or retrospective stud* or twin stud* or systematic review*).md. (1731973)
6 exp methodology/ (58869)
7 5 or 6 (1757145)
8 4 and 7 (5127)
9 222*.cc. (82786)
10 4 and 9 (79)
11 (VERA-2 or ERG22? or ERS or IVPG or 1992-RWA or RF-R or PHS or MMPI-2 or RWA-R or ITFS or ARIS or NBMASA or MEMS or MDFI or RF-I or SyfoR or IFS or SSS or ARIS-S or TCS or TRAP-18 or Schbley or Ross or Vaisman-Tzachor or Horgan or Saucieretal or "Kebbell and Porter" or Monahan or USAID or Borum or EMI-20).tm. (128)
12 (scale* or measure* or assess* or interview* or survey* or instrument*).tw. (1165702)
13 10 or 11 or 12 (1165735)
14 Risk Factor/ or (indicator* or risk factor* or at risk population* or predict* or propensity or likelihood or predispos* or vulnerab* or caus* or determin* or root* or correlate* or develop*).tw. (1405984)
15 8 and 13 (2797)
16 8 and 14 (2691)
17 15 or 16 (3907)
18 limit 17 to (peer reviewed journal and yr="2005 -Current") (2456)

Ovid MEDLINE:
1 exp Terrorism/ (12169)
2 (Radicali* or extremist* or extremism or terrori* or (political adj2 violen*) or (radical* adj2 religio*) or fundamentalism or fundamentalist*).ti,ab,tw. (8904)
3 1 or 2 (17913)
4 clinical trials as topic/ or exp epidemiologic studies/ or exp cohort studies/ or twin studies as topic/ (2466368)
5 (clinical case stud* or clinical trial* or empirical stud* or experimental replication or followup stud* or longitudinal stud* or meta analys?s or metasynthesis or prospective stud* or quantitative stud* or retrospective stud* or twin stud* or systematic review*).tw. (901573)
6 4 or 5 (3006503)
7 3 and 6 (1940)
8 (VERA-2 or ERG22? or ERS or IVPG or 1992-RWA or RF-R or PHS or MMPI-2 or RWA-R or ITFS or ARIS or NBMASA or MEMS or MDFI or RF-I or SyfoR or IFS or SSS or ARIS-S or TCS or TRAP-18 or Schbley or Ross or Vaisman-Tzachor or Horgan or Saucieretal or "Kebbell and Porter" or Monahan or USAID or Borum or EMI-20).ti,ab. (34819)

9 (scale* or measure* or assess* or interview* or survey* or instrument*).tw. (5961082)
10 8 or 9 (5983485)
11 7 and 10 (935)
12 risk factors/ (762648)
13 (indicator* or risk factor* or at risk population* or predict* or propensity or likelihood or predispos* or vulnerab* or caus* or determin* or root* or correlate* or develop*).tw. (10016317)
14 12 or 13 (10263775)
15 7 and 14 (1047)
16 11 or 15 (1417)
17 limit 16 to yr="2005 -Current" (1112)

Science Citation Index (Web of Knowledge):
9 986 #8 AND #3
8 10,056,131 #7 OR #6
7 743,196 TOPIC: (13 (indicator* or risk factor* or at risk population* or predict* or propensity or likelihood or predispos* or vulnerab* or caus* or determin* or root* or correlate* or develop*))
6 9,645,887 #5 OR #4
5 9,444,027 TOPIC: ((scale* or measure* or assess* or interview* or survey* or instrument*))
4 299,580 ALL FIELDS: ((VERA-2 or ERG22? or ERS or IVPG or 1992-RWA or RF-R or PHS or MMPI-2 or RWA-R or ITFS or ARIS or NBMASA or MEMS or MDFI or RF-I or SyfoR or IFS or SSS or ARIS-S or TCS or TRAP-18 or Schbley or Ross or Vaisman-Tzachor or Horgan or Saucieretal or "Kebbell and Porter" or Monahan or USAID or Borum or EMI-20))
3 2,405 #2 AND #1
2 3,005,824 ALL FIELDS: ((clinical case stud* or clinical trial* or empirical stud* or experimental replication or followup stud* or longitudinal stud* or meta analys?s or metasynthesis or prospective stud* or quantitative stud* or retrospective stud* or twin stud* or systematic review*))
1 39,405 TOPIC: ((Radicali* or extremist* or extremism or terrori* or (political NEAR/2 violen*) or (radical* NEAR/2 religio*) or fundamentalism or fundamentalist*))

PubPsych:
(radicalisation OR radicalization OR terrorism OR terrorist OR fundamentalism OR fundamentalist) PY>=2005 PY<=2019

Dblp computer science bibliography:
radicalis|radicaliz|terrori|extremis|fundamentali type:Journal_Articles:
853 results – no limits
324 limited to journal articles only
263 limited to 2005-2019

ACM Digital Library:
Searched for (radicali* terrori* fundamentali* extremis*)
Refinements [remove all] click each refinement below to remove
Published since: 2005

IEEE Xplore:
radicali* OR terrori* OR fundamentali* OR extremis*
in metadata only
Filters applied:
Journals & Magazines

Early Access Articles 2005-2019
SSRN: Searched in Title abstract and Keywords only Radicalization, radicalisation, radicalism
Campbell Library: Searched Radicalisation or Radicalization in general search with no limits
National Criminal Justice Reference Service (NCJRS): Searched Radicalisation OR Radicalization limited to 2005-current

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Appendix D: Network metrics

Network metrics and theoretical implications for the systematic review

Network metric	Definition		Theoretical interpretation
	Description	Formula	
Node-level			
In-Degree	The number of inward directed graph edges from a given graph node in a directed graph.	$D^{+}(v) = \sum_{u=1}^{n} a_{u,v}$	*Endogenous variable*: High in-degree constructs are impacted by multiple other constructs. Thus, it is the propensity to serve as dependent constructs across hypotheses.
Out-Degree	The number of outward directed graph edges from a given graph node in a directed graph.	$D^{-}(v) = \sum_{u=1}^{n} a_{v,u}$	*Exogenous variable*: High out-degree constructs have an ability to change many others. Thus, it is the propensity to serve as independent construct across hypotheses.
Betweenness centrality	Probability that a node occurs at the shortest path (geodesic distance) between any couple of nodes in the graphs.	$B(v) = \sum_{s,d \in V(G)v} \frac{\sigma_{sd}(v)}{\sigma_{sd}}$	*Broker*: Assumes that constructs are important with the shortest paths over mere presence of edges. Connects other constructs or clusters of constructs. Indicates how a concept functions as a crucial explanatory mediator between other concepts.
Closeness centrality	Average distance of a node to all other nodes in a graph, and is defined as the inverse total length.	$C(v) = \frac{1-n}{\sum_{u \in V\, v} d(u,v)}$	The more central a concept is, the closer it is to all other concepts, that is, a central concept is quickly affected by changes in other constructs or vice versa.
Network-level			

Density	Proportion of edges in the network relative to the maximum number of edges.	$\rho(G) = \frac{m(G)}{m_{max}(G)}$	Indicates the parsimony of concepts, e.g., core concepts are heavily researched.

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