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USING COGNITIVE MAPPING TO STUDY THE RELATIONSHIP BETWEEN NEWS EXPOSURE AND COGNITIVE COMPLEXITY

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Abstract Cognitive complexity is a concept that allows scholars to distinguish unidimensional thinking from multidimensional thinking, which allows citizens to identify and integrate various perspectives of a topic. Especially in times of fake news, fact-free politics, and affective polarization, the news media would ideally foster such complex political understanding. The current paper introduces the method of cognitive mapping to measure cognitive complexity regarding citizens' understanding of the financial crisis, one of the most pressing political issues of the past decades. Linking content-analytic data to panel-survey data, we examine how exposure to news about the crisis relates to cognitive complexity. A wide variety of news sources (print, television, and online) were analyzed to take the high-choice media environment into account. Results show that news consumption generally is related to a less cognitively complex understanding of the financial crisis. However, actual exposure to news about the crisis (combined measurement of content analysis and survey data) is positively related to cognitive

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complexity, particularly among less-educated citizens. In addition, the most prominent topics in news coverage were more frequently associated with the financial crisis, as reflected in the cognitive maps of less-educated citizens exposed to more crisis news. These findings demonstrate the potential of news media to increase citizens' complexity of understanding, especially among the less educated.

For democracy to function well, citizens are expected to *understand* political issues sufficiently to cast informed votes and to hold leaders accountable. However, most prior research has examined citizens' knowledge while considerably less attention has been devoted to citizens' understanding. Understanding complex political issues requires more than knowledge alone, and depends on the ability to link concepts to each other into one manageable and accessible cognitive schema (Neuman 1981). This ability involves differentiation—distinguishing among related concepts—and integration—one's understanding of how concepts are linked to one another (Tetlock 1983; Suedfeld 2010). *Cognitive complexity* is the theoretical construct that captures both differentiation and integration (Conway et al. 2014).

Political understanding is especially urgent in times of fake news, fact-free politics, and affective polarization: The capacity to think complexly helps citizens cope better with ambiguous information, think in less unidimensional patterns, and diminishes the tendency to stereotype or opt for aggression (Schroder, Driver, and Streufert 1967; Graber 2001; Sotirovic 2001). Additionally, it allows more nuanced decision-making that takes multiple perspectives into account (e.g., Gomez and Wilson 2001; Sotirovic 2001). Despite the importance of political understanding, little is known about how it may be enhanced or disrupted by news coverage.

The current study introduces a method called “cognitive mapping” that permits valid measurement of the complexity of citizens' political thinking. This method is applied to an event that was particularly challenging for ordinary citizens to understand: the global financial crisis (2009–2016), which has been among the most pressing political issues of the past decades (Hernández and Kriesi 2016). In the case of the financial crisis, cognitive complexity entails, for instance, connecting potential causal institutions (e.g., banking industry), outcomes (e.g., employment), policy measures (e.g., government expenses), and involved actors (e.g., European Union) rather than dogmatically attributing all blame to one cause or actor.

To examine how news consumption relates to complexity of understanding regarding the financial crisis and to zoom in on the cognitive maps of citizens with more versus less news exposure, our study employs a unique combination of three data collection methods: (1) a manual content analysis of news coverage; (2) a panel survey to measure media consumption; and (3) cognitive

mapping to gain insight into citizens' cognitive complexity. Elaborating on the knowledge gap hypothesis (Tichenor, Donohue, and Olien 1970), we assess whether education conditions the relationship between news consumption and cognitive complexity.

Cognitive Complexity, or Just Knowledge?

In times of economic crisis, financial topics become highly salient in the mainstream press (Soroka 2012; van Dalen, de Vreese, and Albæk 2017; Damstra and Boukes 2018). Coverage of the European debt crisis (2009–2015) has been dominated by substantive coverage rather than by strategically or conflict-framed news (Quiring and Weber 2012; Falasca 2014) that emphasized morality, business, or system failures (Bach, Weber, and Quiring 2013; Damstra and Vliegenthart 2018). Frame complexity increased in later stages of the Eurozone crisis (Kleinnijenhuis, Schultz, and Oegema 2015; Picard 2015). Moreover, news about the financial crisis touched upon many issues (Salgado and Nienstedt 2016) and included a rich diversity of interviewed stakeholders (Kalogeropoulos, Svensson, et al. 2015). This coverage thus holds the potential to induce a cognitively complex understanding of the crisis.

News consumption improves citizens' knowledge about politics (Eveland et al. 2005; Jerit, Barabas, and Bolsen 2006), including political-economic issues (Kalogeropoulos, Albæk, et al. 2015), but we lack evidence on whether it increases cognitive complexity. Cognitive complexity consists of two properties: (a) differentiation, the ability to identify and discriminate multiple concepts or dimensions of an issue (see Bieri 1955); and (b) integration, the ability to perceive connections among these concepts (see Neuman 1981). Most existing literature examined citizens' ability to *remember facts* rather than their *understanding* of political issues. However, being able to recall facts (similar to differentiation) is a prerequisite for complex thinking, but does not guarantee that citizens can integrate these in one integrated cognitive scheme (Tetlock 1983; Eveland, Marton, and Seo 2004). Cognitive complexity increases as citizens integrate more concepts into their understanding of a topic. Critically, cognitive complexity does not take correctness or soundness of associations into account—would that even be possible (Tetlock 1983). In other words, it captures the underlying structure of reasoning instead of the actual content of thoughts (Suedfeld 2010).

COGNITIVE MAPPING AS A METHOD FOR STUDYING COGNITIVE COMPLEXITY

This paper introduces the method of cognitive mapping (Axelrod 1976) to the study of public opinion, and cognitive complexity in particular. This technique has been applied in organizational studies, political science, and social

psychology to understand decision-making processes of managers and bankers (Hodgkinson, Maule, and Bown 2004; van Esch and de Jong 2019).

In cognitive maps, concepts are visually depicted as points in a diagram with arrows indicating a causal direction or mutual relationship between them (Axelrod 1976; Hodgkinson, Maule, and Bown 2004). All points (concepts) and arrows (relationships) together depict an actor's belief system. Figure 1 illustrates such a diagram for a sample of hypothetical citizens. The words represent concepts—including objects such as the “banking world,” and conditions such as “economic growth.” Concepts can also include key actors such as public officials and processes. The arrows convey how the concepts are understood to be connected in the minds of the citizen. The direction of the arrow indicates causal direction of the perceived causal effect, the width reflects the relative number of citizens perceiving the connection, and the color of the arrow indicates whether the sign of the effect is positive (light green) or negative (darker purple). For instance, the thick, green downward-pointing arrow reflects that many citizens associate the banking world with having caused the financial crisis, while the thinner, purple line running upward indicates that a smaller number of citizens perceive that the crisis has diminished or harmed the banking community.

The earliest application of cognitive mapping was derived by content analysis of archival texts (Axelrod 1976), but recent techniques allow respondents to draw their own cognitive map (van Esch, Joosen, and van Zuydam 2016). This allows a bottom-up reflection of the issue under study. Respondents can create their personal cognitive map in two ways (Hodgkinson, Maule, and Bown 2004): (a) pairwise judgments of causal relationships between potential concepts, or (b) a freehand approach in which actors *visually* express their belief system.

Our study employs the freehand approach, which has multiple advantages over pairwise judgments. Similar to the knowledge structure density

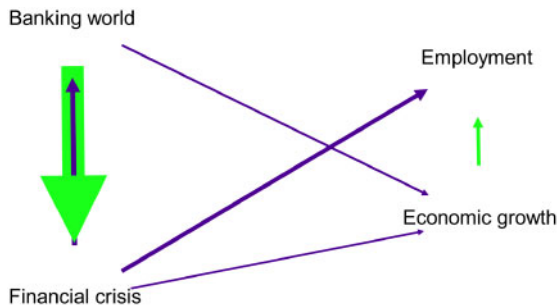


Figure 1. Visual illustration of a composite cognitive map of the financial crisis for a hypothetical sample of citizens.

measurement (Eveland, Marton, and Seo 2004), explicit pairwise judgments are obtrusive (Axelrod 1976) and impose researchers' conceptual frameworks upon the respondents (Young and Schafer 1998; Gaxie, Hubé, and Rowell 2011). Cognitive maps generated through the freehand approach, by contrast, are the outcome of actors searching their own memory of how they perceive the relationships between concepts (Hodgkinson, Maule, and Bown 2004). This results in fewer false positives (inferred associations that do not exist in one's belief system) and more accurately reflects how people would respond in real life. Finally, the freehand approach is quicker to administer, respondents find the task relatively easy, and they perceive the result as more representative of their thoughts (Hodgkinson, Maule, and Bown 2004).

HOW NEWS EXPOSURE CAN PROMOTE COGNITIVE COMPLEXITY

While abundant evidence exists that news consumption may contribute to factual political-knowledge gain (Norris and Sanders 2003; Jerit, Barabas, and Bolsen 2006; Boukes and Vliegthart 2019), little is known about the effect that mediated information may have on cognitive complexity (Sotirovic 2001; Hutchens, Hmielowski, and Beam 2015). News coverage generally oversimplifies the world because it is impossible to cover all aspects in a single news item (Hilgartner and Bosk 1988) and only one or a few "aspects of a perceived reality" (Entman 1993, p. 52) will be selected. Moreover, by consuming news, one does not necessarily come across much information about politically relevant issues, as such content may be overshadowed by distracting soft news topics that include crime, disaster, or celebrity news (Patterson 2000; Baum 2003). News consumption therefore may not promote cognitive complexity regarding one specific issue (Luskin 1990; Eveland and Schmitt 2015). In contrast, it is possible that news consumption makes people feel they understand the political world less (Woodstock 2014) and reduces their understanding of economic issues (Jansen and Neuenkirch 2018).

Rather than consuming the news, it is the quantity of *relevant* political information to which one is exposed that can have a positive effect (Jerit, Barabas, and Bolsen 2006; Elenbaas et al. 2013). Accordingly, the content of news outlets in combination with the actual exposure to these outlets needs to be explored (de Vreese et al. 2017) to assess whether news consumption, generally, or the actual exposure to issue-specific news stories increases cognitive complexity (see Eveland and Schmitt 2015). The media covered the financial crisis substantively from a variety of perspectives (Quiring and Weber 2012; Falasca 2014), with multiple actors (Kalogeropoulos, Svensson, et al. 2015), and an increasing level of complexity (Kleinnijenhuis, Schultz, and Oegema 2015). Exposure to such news may thus provide the necessary information to elaborate on the topic and increase the complexity of citizens' understanding of the

crisis. Accordingly, we differentiate between news consumption generally and exposure to coverage of the financial crisis specifically. This leads to two hypotheses:

H₁: News consumption in general is not positively related to cognitive complexity about the financial crisis.

H₂: Exposure to news coverage about the financial crisis is positively related to cognitive complexity about the financial crisis.

ARE THE EFFECTS OF SPECIFIC NEWS EXPOSURE CONDITIONAL?

The knowledge gap hypothesis (Tichenor, Donohue, and Olien 1970) predicts that people of higher socioeconomic status acquire information more effectively from the media than less-educated citizens. Liu and Eveland (2005, p. 910), however, wrote that “the research literature is full of findings inconsistent with the original expectation.” Media are especially adequate in informing the citizens with *lower* levels of education or ability (Chaffee and Kanihan 1997; Eveland and Scheufele 2000; Shehata et al. 2015 found similar results regarding knowledge). Our expectation is that a similar relationship exists concerning *cognitive complexity*, given how the same processes are likely to occur.

News consumption may reduce rather than amplify the gap between citizens of high and low levels of education (Eveland and Scheufele 2000; Jebril et al. 2013). After all, highly educated citizens often have more alternative sources of information (education, professional experiences, etc., Luskin 1990; Robinson and Davis 1990) that restrict the impact of new sources of information (Jennstål 2019). However, for less-educated citizens, the media may help them gain more knowledge and increase understanding of how certain concepts are associated. Accordingly, news media potentially reduce the knowledge gap between citizens with higher versus lower levels of education (Chaffee and Kanihan 1997; Boukes and Vliegenthart 2019). Assuming that the same rationale holds true for cognitive complexity, we expect a contingent effect:

H₃: The effect of exposure to news coverage about the financial crisis on cognitive complexity strengthens for citizens with lower levels of education.

If the positive relationship between the exposure to news about the crisis and cognitive complexity is indeed stronger among less-educated citizens, substantive differences in the content and structure of their cognitive maps should emerge for those with more versus less crisis news exposure. Arguably, the relationships between concepts frequently associated with the crisis in news coverage should be more prominent in citizens’ cognitive maps. To understand the differences between lower educated citizens exposed to more or less news

about the financial crisis, we qualitatively analyze their aggregated cognitive maps:

RQ₁: *How do the cognitive maps of citizens with lower levels of education differ between those who are exposed to more versus less news about the crisis?*

Methods

Data were collected in the first half of the year 2015 in the Netherlands. Although early signs of economic recovery were witnessed at the aggregate level (e.g., stock-market improvement; GDP increase), the economic situation was still experienced as “in crisis” and consumer confidence was low (Boukes, Damstra, and Vliegenthart 2019) because the most tangible economic indicators for individual citizens had not yet improved much (e.g., high unemployment, low house prices). Therefore, the central concept within this study was “financial crisis,” a concrete construct with which actors, events, and other economic concepts could be relatively clearly associated.

CONTENT ANALYSIS OF ECONOMIC NEWS COVERAGE

A content analysis of Dutch news was conducted for the period from February to July 2015. Due to the high-choice media environment (Prior 2007), it was important to investigate a wide array of outlets. Without clear partisan news media in the country, a census of all economic news items of the most popular mainstream news outlets was manually annotated for the presence of crisis news (see table 1).

Newspaper articles about the economy were retrieved from *LexisNexis* and stored in the Amsterdam Content Analysis Toolkit (AmCAT; van Atteveldt et al. 2014) using an inclusive search string (Boukes et al. 2020). Website items were scraped from RSS feeds and stored within Infrastructure for Content Analysis (INCA; Trilling et al. 2018) using the same search string and a 25 percent sampling.¹ Within the retrieved articles, coders manually verified whether each item dealt with economic news. For television news, economic news items were manually identified by watching the full programs. Altogether, this resulted in 7,076 economic news items.

Measurement and reliability. Within all these economic news items, a team of 22 student coders analyzed whether a news item *explicitly* referred to either the “economic crisis” or “financial crisis.” They could simply answer this by

1. For the most popular news website *Nu.nl*, all economic articles were selected and analyzed.

Table 1. Overview of news media outlets used in the content analysis (and survey questions), and their number of economic news items (n) and news items about the crisis (n_{crisis})

Modality	Outlet	Genre/broadcaster	n	n_{crisis}
Newspaper	<i>Algemeen Dagblad</i>	Popular	455	64
Newspaper	<i>de Telegraaf</i>	Popular (with large finance section)	1,078	138
Newspaper	<i>Metro</i>	Popular (free)	86	7
Newspaper	<i>NRC Handelsblad/Next</i>	Quality	628	142
Newspaper	<i>Trouw</i>	Quality	428	91
Newspaper	<i>de Volkskrant</i>	Quality	562	102
Newspaper	<i>Financieel Dagblad</i>	Financial	1,317	211
Newspaper	<i>Noordelijk Dagblad</i>	Regional	460	41
Newspaper	<i>Noordhollands Dagblad</i>	Regional	303	36
Newspaper	<i>de Gelderlander</i>	Regional	369	30
Television	<i>NOS Journaal (20.00 PM)</i>	News / Public broadcaster	77	15
Television	<i>NOS op 3</i>	News / Public broadcaster	21	5
Television	<i>RTL Nieuws (19.30 PM)</i>	News / Commercial broadcaster	78	14
Television	<i>EenVandaag</i>	Current affairs / Public broadcaster	24	4
Television	<i>Nieuwsuur</i>	Current affairs / Public broadcaster	64	14
Television	<i>RTL-Z</i>	Financial / Commercial broadcaster	142	21
Internet	<i>Nu.nl</i>	Stand-alone news website	49	4
Internet	<i>Telegraaf.nl</i>	Website of popular newspaper	301	37
Internet	<i>Volkskrant.nl</i>	Website of quality newspaper	217	28
Internet	<i>NRC.nl</i>	Website of quality newspaper	170	30
Internet	<i>NOS.nl</i>	Website of public broadcasting news	247	28
Total			7,076	1,062

means of a yes (1) or no (0). In total, 1,075 items (15.1 percent) were identified as dealing with the crisis. Additionally, the coders identified the main economic topic of an article using an extensive list of 60 topics as well as its main

noneconomic topic (from a list of 25 general news topics following the Comparative Agendas Project Master Codebook; [Bevan 2014](#)).

A random selection of 248 newspaper and website articles was assessed by multiple coders to assess intercoder reliability. Reliability statistics were calculated using Nograd 1.1 ([Wettstein 2018](#)). The reliability in identifying crisis-related news was satisfactory, especially considering the large number of coders. For crisis news (Krippendorff's $\alpha = 0.62$, Holsti's percent agreement 93.8 percent, Scott's $\pi = 0.72$, standardized Lotus = 0.87). Similar scores emerged for the categorical variables related to the topics covered: economic main topic ($\alpha = 0.64$, standardized Lotus = 0.83) and noneconomic main topic ($\alpha = 0.59$, standardized Lotus = 0.76).

SURVEY OF DUTCH ADULTS

During the same period as the content analysis, a three-wave panel survey among Dutch adults was conducted by I&O Research. Only the first wave (fielded on February 23, 2015) and the last wave (fielded on June 15, 2015) are used since all relevant independent, control, and criterion variables were tapped in either Wave 1 or Wave 3. After inviting 22,879 panel members, 9,112 people started the first questionnaire (RR2 = 39.8 percent) of which 6,386 completed the survey (RR1 = 27.9 percent; cooperation rate, COOP1 = 70.1 percent). With an attrition rate of 28 percent per wave, 3,270 respondents completed the last survey wave, of whom 2,511 also completed the cognitive mapping exercise. Although I&O's pool of respondents was recruited using random sampling from population registers, it was not fully representative of the Dutch population in that respondents were older than average (18–91 years of age, $M = 61.32$, $SD = 11.14$), and included an overrepresentation of males (66.2 percent) and more highly educated people (50.5 percent). The large sample size, however, leaves sufficient observations in the investigated subsamples for a qualitative analysis of their cognitive maps.

Measurements: independent variables. News consumption was measured by asking how many days per week respondents read/watched the specific news outlets for which the content analysis was conducted (see [table 1](#)). Responses were recoded to range from 0 (no consumption of outlet) to 1 (maximal/daily consumption) and summed to measure total news consumption. On average, respondents consumed news from 3.88 ($SD = 1.82$) outlets per day.

Exposure to news about the financial crisis. To measure actual exposure to news about the crisis, data of the content analysis were combined with the news consumption variables. For every individual respondent (i), the

frequency of consumption of a certain outlet (k) is multiplied by the summed number of news items about the economic crisis within this outlet k in the four months prior to the last survey wave:

$$\text{Exposure to crisis news}_i = \sum \text{Consumption of [outlet } k_i] \\ \times \text{Presence of crisis news in [outlet } k]$$

This variable indicates the number of news items about the financial crisis that a respondent would have been exposed to before taking the final survey and drawing their cognitive map. On average, there were 130.23 news items with large variation between respondents ($SD = 98.56$).

Moderator: education. In line with Tichenor and colleagues (1970) and following the guidelines of UNESCO's International Standard Classification of Education (ISCED 2011), we distinguish three levels of education. *Lower education* includes primary education only, preparatory vocational secondary education (lower level of secondary education, in Dutch: LTS or VMBO), and less than three years of secondary school at the two highest levels. This low-education group has not finished professional education and stopped studying after or during secondary school. *Intermediate education* includes intermediate vocational education (in Dutch: MBO), and the last three years of secondary school within the two highest levels (senior general secondary or university preparatory education; in Dutch: HAVO and VWO). *Higher education* includes higher professional education (in Dutch: HBO) and research-oriented university education (in Dutch: WO).

All three levels of education—lower ($n = 435$, 17.5 percent), intermediate ($n = 745$, 29.9 percent), and higher education ($n = 1,309$, 52.6 percent)—are well represented in our sample. Education is treated as a categorical variable in the analysis with a dummy coding scheme that has intermediate education as the reference category.

Control variables. To reduce the likelihood of omitted variables bias, analyses controlled for age, gender, political knowledge, efficacy, interest, ideology, discussion frequency, and survey duration. Moreover, dummy variables were included for whether people personally had positive economic experiences (found a job, salary raise, or promotion) or negative personal experiences (becoming unemployed, salary decrease) in the past four months.

Dependent variable: cognitive complexity using cognitive mapping. Cognitive mapping represents belief structures as the combination of concepts one has in memory and the perceived relationships among these concepts

(Young 1996). This is highly comparable to the differentiation and integration elements in cognitive complexity (Tetlock 1983). Hence, the cognitive mapping technique offers an empirical measure that closely approximates the theoretical construct of cognitive complexity (Young 1996).

At the end of the third wave of the survey, respondents were forwarded to the web application DART in which cognitive maps were directly elicited using the freehand approach.² To draw their map, respondents were first asked to select a maximum of seven out of a list of 47 predefined concepts (see appendix B). “Financial crisis” was preselected. Although the 47 predefined concepts slightly limited the bottom-up character of the task, it still provided respondents with 4,418 (47×47 concepts \times 2 relationship types) possible relationships to draw.

Subsequently, respondents were asked to draw arrows between the concepts to indicate how they perceived them to be linked. The direction of the arrow indicated the direction of the perceived causal effect, while the color of the arrow indicated whether the effect was deemed to be positive (light green) or negative (darker purple).³

How cognitively complex, varied, and interconnected individuals’ belief systems are (Suedfeld and Tetlock 1977; Young and Schafer 1998) can be calculated by the number of (in- and outgoing) relationships between concepts in the map, thereby summarizing the number of causes and consequences that a person associates with the concepts (Shapiro and Bonham 1973): More cognitively complex belief systems are more interconnected (i.e., less unidimensional). On average, respondents have drawn 2.41 ($SD = 1.42$) associations between the *financial crisis* and related concepts, with a maximum of 12. Although this may not seem like a lot, it corresponds with previous research that citizens generally have low levels of cognitive complexity (Van Hiel and Mervielde 2003) and only few are able to make real abstractions (Neuman 1981). Because only 1.47 percent of the sample had drawn seven or more associations with the financial crisis concept, these were grouped together, thus resulting in a scale from 0 to 7.

Validity of cognitive mapping as a measurement of cognitive complexity. If the characteristics of cognitive maps are valid indicators of cognitive complexity, they should be correlated with theoretically relevant criterion variables

2. This video shows the procedure respondents experienced while creating their personal cognitive map: https://osf.io/ewbkm/?view_only=2972642f46804a609653589ad9455823.

3. The use of a negative key concept (financial crisis) raised issues for the analysis. When respondents connect a cause-concept with a negative arrow to the concept of financial crisis, in essence, they are making a double negative statement. A comparison between how respondents connected the concept “banking world” to financial crisis and their answers to the open-ended survey question “Who or what is responsible for the financial crisis?” confirmed that this caused confusion for some. All double negative statements of these respondents were corrected.

(Cronbach and Meehl 1955; Treiman 2014). We identified five such criterion variables. First, the differentiation part of complexity has also been coined political knowledge or “knowledge-in-use” (Neuman 1981, p. 1240), which is a precondition for integration (Suedfeld 2010). Hence, more *knowledge* should be related to more complexity, also because it increases the need to organize one’s ideas (Neuman 1981; Luskin 1987). Second, *education* not only reflects people’s general level of intelligence, it in particular strengthens people’s ability to reflect and think in abstract terms, thus allowing more complex thinking (Neuman 1981; Jennstål 2019). *Internal political efficacy* captures whether people believe they are able to understand and participate in politics (Niemi, Craig, and Mattei 1991), and could thus be regarded as a self-reported measure of cognitive complexity. *Interest* in a topic encourages the search for more (political) information (Luskin 1990), and therefore would relate to higher cognitive complexity. Moreover, engaging in *political discussions* increases complexity of thinking, not due to knowledge gain per se (Jennstål 2019) but because it encourages people to elaborate on a topic (Eveland 2004).

Finally, it is possible that the complexity of cognitive maps is simply an artifact of respondent effort. Respondents who are more thoughtful in answering questions throughout the survey, or those high in verbal fluency, might simply spend more time drawing their cognitive map. If so, the number of concepts and connections could be an artifact of effort. To rule this out, we would hope that cognitive complexity is *not* correlated with *survey response duration* (O’Keefe and Sypher 1981).

Validity criterion measurements. *Factual knowledge* was measured by 11 multiple-choice questions ($M = 8.08$, $SD = 2.16$; full details in appendix A). As an alternative knowledge measure, we asked respondents to *estimate the unemployment rate* and calculated the difference with the real rate (logarithmically transformed to deal with outliers). *Internal political efficacy* was measured with three items asking how well respondents believed they were able to discuss economic issues, understand economic matters, and feel informed about the economy compared to others (Cronbach’s $\alpha = 0.89$). *Current affairs interest* was measured by combining two items regarding people’s interest in politics and economics ($\alpha = 0.75$). *Political discussion frequency* was tapped by two questions asking how frequently people discussed economic or political topics ($\alpha = 0.87$). *Duration of survey response* was measured as the number of minutes it took respondents to complete the last survey ($M = 32.31$, $SD = 25.75$).

Criterion-oriented validity. Pairwise correlation analyses were run with cognitive complexity and the criterion variables to verify whether the number of

Table 2. Tests of criterion-oriented validity using bivariate correlation with cognitive complexity

Criterion variables	Bivariate correlation	
	<i>r</i>	<i>p</i>
Factual knowledge	0.06	0.001
Δ estimate unemployment (log)	-0.12	0.000
Education (low, intermediate, high)	0.15	0.000
Internal efficacy	0.08	0.000
Current affairs interest	0.02	0.235
Current affairs discussion frequency	0.07	0.001
Survey response duration	0.01	0.484

NOTE.—Cells contain coefficients of Pearson correlation with cognitive complexity (*r*), and probabilities (*p*; two-tailed).

associations with the financial crisis in the cognitive map is a valid measurement of cognitive complexity. The number of associations with financial crisis in cognitive maps (i.e., dependent variable) indeed correlated in the expected direction with the two factual knowledge variables, education, internal self-efficacy, and current affairs discussion frequency (see [table 2](#)). Surprisingly, cognitive complexity was positively, but not significantly, correlated to current affairs interest; we elaborate on this finding in the discussion. No significant correlation was found with survey response duration, which further increased trust in the validity of cognitive complexity's measurement.

Results

TOPICS IN CRISIS NEWS

Three specific topics were particularly prominent in news coverage about the financial crisis (see [fig. 2](#)): the Greek debt crisis with a heavy focus on a possible Grexit; general economic developments; and economic decline or growth. Other heavily covered topics within this news were the role of banks, (un)employment, and the housing market.

While the majority of news items solely focused on economic news (58.4 percent), some economic news stories also contained a central noneconomic topic. Most visible among the noneconomic main topics were political issues, especially European Union politics (15.1 percent of the items) and national politics (7.7 percent). All other noneconomic main topics were only marginally visible (3 percent or less).

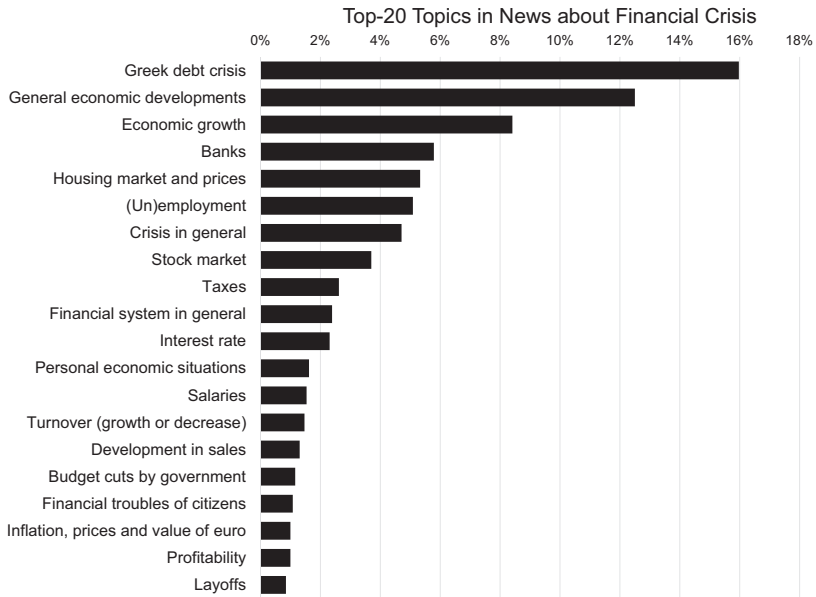


Figure 2. Top 20 most visible topics in news about the financial crisis. From content analysis of 7,076 newspaper, television, and internet news stories, February 2015–July 2015.

COGNITIVE MAPS

To provide a visualization of what the aggregated cognitive map of all respondents looks like, network software *Gephi* (Bastian, Heymann, and Jacomy 2009) was used to create figure 3. Eleven concepts were used an above average number of times, seven of which overlap with the most prominent issues reported in crisis news coverage. One relationship in particular stands out: The association between the financial crisis and banking world is unique in its consistency and strength. The banking world as well as government spending, Grexit, European leadership, and globalization are generally more often perceived as *causes* of the financial crisis than as being affected by it. By contrast, (un)employment, economic growth, the housing market, financial stability, and uncertainty are generally perceived to be *outcomes* of the crisis. Overall, these cause-effect relationships make sense, thus strengthening our confidence in the measurement method.

NEWS CONSUMPTION, CRISIS NEWS EXPOSURE, AND COGNITIVE COMPLEXITY

Table 3 shows the results of regression models predicting cognitive complexity of the financial crisis. Regarding the control variables, more cognitive

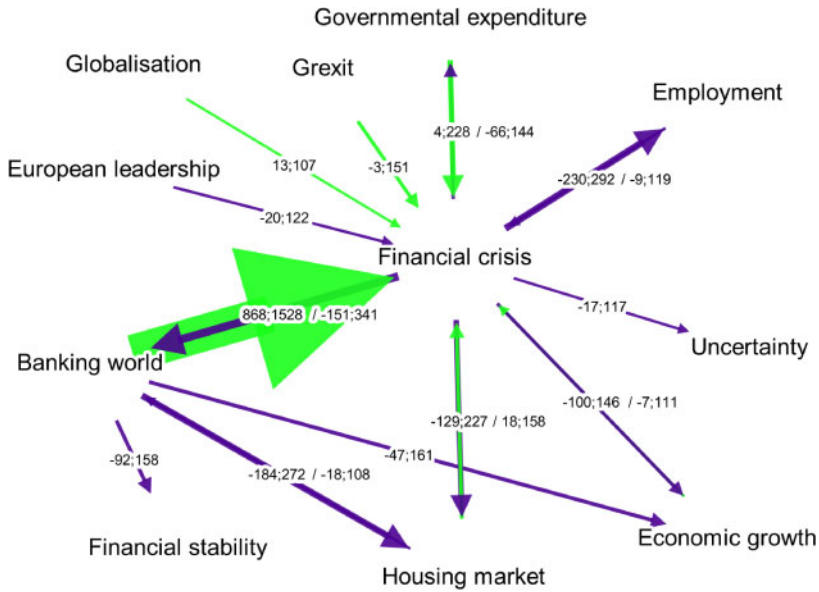


Figure 3. Excerpt of aggregated cognitive map with 11 most salient concepts and the 18 most salient relations. Light green color represents positive associations and darker purple color represents negative relationships. The labels (a;b) report two alternative metrics for the strength of the relationship. The number before the semicolon (a) is net positivity: the total number of positive arrows minus the number of negative arrows drawn by respondents. The number after the semicolon (b) is the total weight of the relation (i.e., the number of drawn relationships). For concepts that have arrows going back and forth, two labels are visible separated by a slash (a;b/a;b), whereby the first pair refers to the largest arrow between the concepts.

complexity was found among the higher educated, younger, more knowledgeable, and more politically efficacious citizens. Interestingly, citizens who placed themselves on the left side of the political spectrum scored higher on complexity. This corresponds with what is known of political elites such as political candidates (Conway et al. 2016) and justices (Tetlock, Bernzweig, and Gallant 1985). On top of that, model 1 finds a negative relationship between news consumption (irrespective of content) and complexity of one’s understanding of the financial crisis. This finding supports H₁: With every extra news outlet that one consumed daily, the number of associations in the cognitive map decreased 0.07 points (i.e., a positive relationship did not emerge).

Model 2 adds the number of crisis news items that citizens were exposed to before drawing their cognitive map. To include news consumption and crisis

Table 3. OLS regression models predicting cognitive complexity

Independent variable	Model 1: News consumption			Model 2: Exposure to crisis news			Model 3: Interactions with education		
	B	(S.E.)	p	B	(S.E.)	p	B	(S.E.)	p
Intercept	3.52	(0.24)	0.000	3.54	(0.24)	0.000	3.38	(0.27)	0.000
Lower education	-0.10	(0.08)	0.232	-0.10	(0.08)	0.236	0.16	(0.20)	0.04
Higher education	0.29	(0.06)	0.10	0.29	(0.06)	0.10	0.51	(0.16)	0.18
Survey response duration	0.00	(0.00)	0.06	0.00	(0.00)	0.06	0.00	(0.00)	0.06
Age	-0.03	(0.00)	-0.21	-0.03	(0.00)	-0.21	-0.03	(0.00)	-0.21
Gender (0 = male, 1 = female)	0.10	(0.06)	0.03	0.09	(0.06)	0.03	0.09	(0.06)	0.03
Positive economic experiences	0.12	(0.19)	0.01	0.11	(0.19)	0.01	0.12	(0.18)	0.01
Negative economic experiences	-0.15	(0.17)	-0.02	-0.15	(0.17)	-0.02	-0.16	(0.17)	-0.02
Political ideology (left-right)	-0.04	(0.01)	-0.06	-0.04	(0.01)	-0.06	-0.04	(0.01)	-0.06
Factual knowledge	0.04	(0.01)	0.06	0.04	(0.01)	0.06	0.04	(0.01)	0.06
Internal efficacy	0.03	(0.01)	0.07	0.03	(0.01)	0.07	0.03	(0.01)	0.07
Current affairs interest	-0.01	(0.02)	-0.01	-0.01	(0.02)	-0.01	-0.01	(0.02)	-0.01
Current affairs discussion frequency	0.03	(0.02)	0.04	0.03	(0.02)	0.04	0.04	(0.02)	0.04
News consumption	-0.07	(0.02)	-0.08	-0.07	(0.02)	-0.10	-0.03	(0.04)	-0.03
Exposure to crisis news				0.00	(0.00)	0.02	0.00	(0.00)	0.00
Lower education × news consumption							-0.15	(0.07)	-0.18
Higher education × news consumption							-0.05	(0.05)	-0.08
Lower education × crisis news exposure							0.00	(0.00)	0.12
Higher education × crisis news exposure							-0.00	(0.00)	-0.01
R ²	0.092			0.093			0.096		
N	2,453			2,453			2,453		

NOTE.—Cells include, for each independent variable, unstandardized coefficients (B), robust standard errors in parentheses (S.E.), standardized coefficients (β), and two-tailed probabilities (*p*).

news exposure in one model, these variables should not correlate too strongly. With $r = 0.77$, this turned out to be unproblematic ($VIF < 2.5$). A positive but nonsignificant relationship ($\beta = 0.01$, $p = 0.625$) emerged between crisis news exposure and cognitive complexity; thus, we found no support for H_2 .

Model 3 adds interactions between crisis news exposure and education to examine whether the relationship with cognitive complexity is conditional upon education. Because of the strong correlation between crisis news exposure and general news consumption, it is necessary to also include interactions with the latter to avoid spurious relationships. Two interesting patterns are found. First, the interaction between lower levels of education and news consumption was significant. In other words, news consumption had a negative relationship with cognitive complexity only among less-educated citizens (see [fig. 4](#)), with an insignificant main negative effect of news consumption (i.e., for the reference category, or those with an intermediate level of education). News consumption thus did not significantly relate to complexity about the financial crisis among citizens with intermediate and higher levels of education.

By contrast, there was a significant and positive interaction effect of exposure to crisis news on cognitive complexity among less-educated respondents ($\beta = 0.12$, $p = 0.022$). As shown in [figure 5](#), less-educated citizens exposed to more crisis news have a more complex understanding of the financial crisis when compared with their counterparts who had been exposed to less crisis news. This effect of crisis news coverage did not occur among citizens of intermediate and higher education. Evidence is thus found in support of H_3 .

Among less-educated citizens, then, the data indicate both a positive relationship between exposure to crisis news and cognitive complexity as well as a negative relationship between general news consumption and cognitive

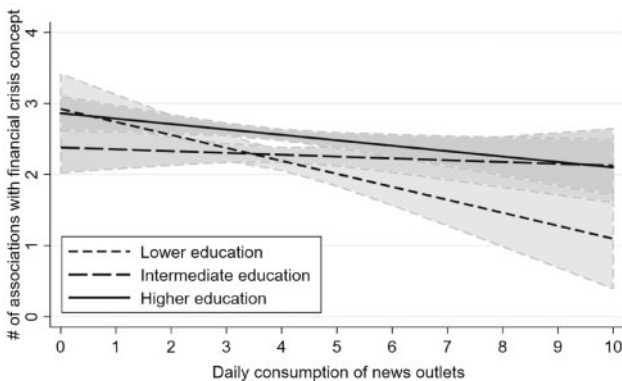


Figure 4. Estimated cognitive complexity regarding the financial crisis for different levels of education when citizens consume more (right side) or fewer news outlets (left side) with 95 percent confidence interval.

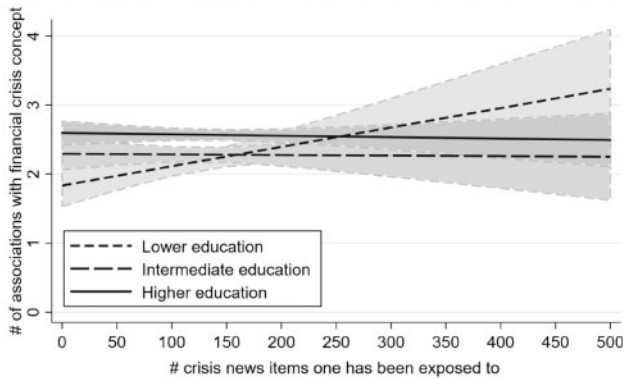


Figure 5. Estimated cognitive complexity regarding the financial crisis for different levels of education when citizens are exposed to more (right side) or less news items about the crisis (left side) with 95 percent confidence interval.

complexity. As such, the overall relationship is complex, not surprising given that both independent variables are inherently correlated ($r = 0.77$). After all, less-educated citizens who are exposed to more news about the crisis specifically (which increases cognitive complexity) will also see more news in general (which decreases cognitive complexity). For example, if one compares (a) an average group of lower-educated citizens with a mean level of crisis news exposure to (b) a group of lower-educated citizens with one standard deviation (+1 *SD*) more crisis news exposure, one should also assume that the latter group has a 0.77 standard deviation higher general news exposure. Accordingly, their cognitive complexity will go up with another +0.12 *SD* (see model 3) but also decrease with an additional 0.14 points (i.e., 0.77×-0.18). These effects thus cancel each other out under normal circumstances. Cognitive complexity consequently only increases if lower-educated news audiences shift their attention to news media in which they are more likely to be exposed to issue-relevant news (in our case, quality and financial newspapers; see table 1) while at the same time tuning out from media that cover the topic less frequently.

Altogether, this raises the question of how the cognitive maps of less well-educated people with more (+1 *SD*, $n = 39$) versus less (-1 *SD*, $n = 75$) exposure to crisis news substantively differed in terms of content and complexity. Reviewing the relationships between the 10 most salient concepts in their maps reveals a high level of overlap (9 out of 10) in chosen concepts (see figs. 6 and 7). The only difference is that those with little crisis news exposure identified social security as the sixth most salient concept, whereas highly exposed respondents selected European subsidies. As European Union politics

was a prominent topic in news about the crisis, this is a first sign that issue-relevant news exposure informed people’s cognitive map.

Looking at the *relative* salience of drawn associations, clearer differences emerge. Respondents with less crisis news exposure associated the crisis more frequently with the concepts of employment, inflation, and government expenditure (fig. 6). Respondents with more crisis news exposure, by contrast,

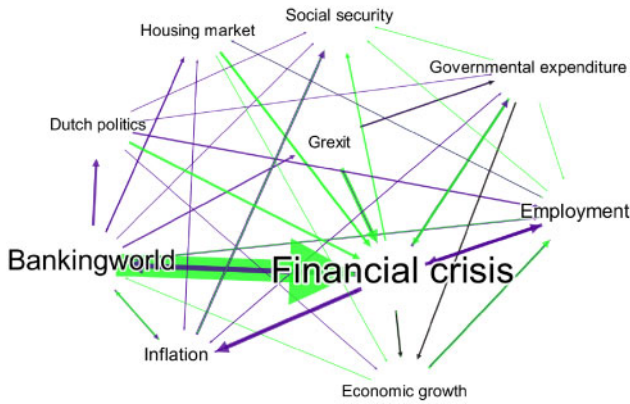


Figure 6. Cognitive map of low-educated respondents with less than average (-1 SD) crisis news exposure (top 10 most salient concepts; the larger the concept/relation, the higher its saliency). Relationships that are on average perceived as positive are drawn with light green color and negative relationships in darker purple color ($n = 75$).

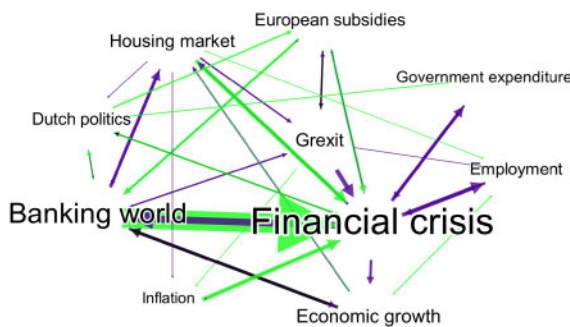


Figure 7. Cognitive map of low-educated respondents with more than average (+1 SD) crisis news exposure (top 10 most salient concepts; the larger the concept/relation, the higher its saliency). Relationships that are on average perceived as positive are drawn with light green color and negative relationships in darker purple color ($n = 39$).

perceived the concepts of economic growth, Grexit, the housing market, and Dutch politics as relatively more salient (fig. 7). Interestingly, the latter topics were the most salient topics in the news about the financial crisis. Thus, a clearer correspondence exists between the cognitive maps of less-educated citizens exposed to *more* news about the crisis and the topics that were most prominent in the news about this topic. Hence, differences in cognitive complexity among lower-educated citizens can partly be explained by the amount of exposure to news about this topic.

A second remarkable difference concerns the role of the banking world. Whereas both groups believe that banks are the main instigator of the financial crisis, the extent to which differs. Among lower-educated respondents with *most* crisis news exposure, 65 percent indicated that the banking world is a major cause of the crisis, while 35 percent suggested that the banking world prevented the crisis. Among lower-educated respondents with *little* crisis news exposure, the respective proportions are 54 percent and 46 percent. Moreover, while only 33 percent of the connections drawn by respondents with less news exposure indicate that the financial crisis has a negative effect on the banking world, for respondents with most crisis news exposure, this figure is 75 percent. Hence, the understanding of those with more frequent exposure to crisis news was more cognitively complex: They tend to identify the reciprocity and backlash in the relationship between banks and the crisis as well as adhere to the—by now commonly accepted—idea that banks have (partly) caused the crisis.

Another major difference between the two groups with less education is that individuals with more frequent exposure to crisis news, overall, drew about twice (6.74) as many relationships between the concepts in their maps as those with less exposure (3.10). The connectedness of the top 10 concepts identified by the respondents with high media exposure is between 1.6 and 2.6 times higher than the connectedness of the low-exposure group.

Discussion

Understanding of the financial crisis becomes more cognitively complex among those with most exposure to issue-relevant news items, but only among the lower-educated citizens, and for many this effect will cancel out if general news consumption is higher too. People with less education may thus have benefited most from exposure to issue-relevant news (Eveland and Scheufele 2000; Shehata et al. 2015; Boukes and Vliegenthart 2019 found similar results regarding knowledge). This finding implies that media may help lower-educated citizens achieve more cognitively complex understanding by teaching them how to “connect the dots” (Hansen and Pedersen 2014) on a certain issue by covering it heavily. Qualitative inspection of their aggregated cognitive

maps revealed that those concepts that featured prominently in news coverage about the crisis also featured more dominantly in the maps of low-educated respondents with more news exposure. Although regarding a conceptually different outcome, we thereby find evidence contradicting Tichenor, Donohue, and Olien's (1970) well-established knowledge gap hypothesis. As the cognitive mapping exercise happened *after* the measured exposure to crisis news, but was only included once in the panel survey, no changes in cognitive complexity could be observed. Hence, one should be careful not to draw firm conclusions about causal direction.

Whereas exposure to news about the financial crisis could thus increase cognitive complexity, the opposite was found for news consumption generally (irrespective of content). Potentially, the dominance of sensational topics could have distracted citizens from an issue as complex as the financial crisis (Patterson 2000; Baum 2003). Moreover, the news is often perceived as too complicated, abstract, and irrelevant (Bird 1998), which may generally harm perceived comprehension of current affairs (Costera Meijer 2003; Woodstock 2014). Just consuming the news without actual exposure to issue-relevant information therefore could decrease the complexity of citizens' understanding.

Tests of cognitive mapping's criterion-oriented validity have shown that this measurement of cognitive complexity and most criterion variables were significantly correlated in the expected direction. However, correlations were rather weak ($r \leq 0.15$), which suggests the presence of considerable measurement error. Arguably, the employed measurement was not very precise, as may be expected from a newly developed method. Further research is needed to verify the reliability of cognitive mapping as a method to measure cognitive complexity and to experiment with different instructions, interfaces, or rewards to ease respondents' experience while drawing their cognitive maps. The insignificant correlation between cognitive complexity and current-affairs interest is surprising given that interest functions as a proxy for related concepts, such as information-seeking (Luskin 1990). Given that interest captures the *motivation* to learn about political matters, this finding potentially speaks to the theoretical need to separate the *motivation* and *ability* of processing political information (Lecheler and de Vreese 2017). Indeed, cognitive complexity theoretically has been defined as the *ability* to differentiate and integrate concepts when thinking about a topic (Tetlock 1983; Suedfeld 2010). Hence, the introduced measurement through cognitive mapping could be a powerful way to measure the ability to understand politics in isolation from people's motivation to do so.

Although following recommendations to enhance the precision of news consumption self-reports (asking concrete frequency and specific outlets; see Andersen, de Vreese, and Albæk 2016), the unavoidable measurement error in the independent variable will have caused a downward bias toward the null hypothesis (Scharkow and Bachl 2017). Arguably, our findings present conservative results and have revealed only a small portion of the true relationship

between exposure to issue-relevant news and cognitive complexity. Experimental research can overcome the known difficulties of media consumption measurements (Prior 2009) and unreliability in the manual detection of content features.

Incorporating cognitive mapping in experimental follow-up studies will also allow for assessing the differential effects of specific content features on cognitive complexity. For instance, the framing or language complexity of political news may influence cognitive complexity (Tolochko, Song, and Boomgaarden 2019). Alternatively, modality of news coverage could play a role: Neuman (1981, p. 1265) already suggested that “vague and shallow” media coverage could be the source of a generally low level of cognitive complexity. Yet some media may be better suited to generate complex belief systems than others (Prior 1985; Sotirovic 2001)—for example, by putting events into perspective and relating these to other topics rather than just episodically framing the news (Iyengar 1991). Additional analyses on our data indeed show that the interaction effect between education and crisis news exposure is only replicated for newspapers, but not for TV news or (free) online news.⁴ Printed news potentially increases complexity due to its more sophisticated nature and because it allows citizens to consume articles at their own pace (Postman 1986; Robinson and Davis 1990); television may be too superficial and go too fast to benefit comprehension.

Moreover, the overrepresentation of older respondents could have restricted the influence of online news, which is particularly effective for younger people (Eveland, Marton, and Seo 2004). The generation that has grown up with the internet, however, may be less likely to store information in memory (because they can always look it up online; Kleinberg and Lau 2019); hence, one may question how this affects their cognitive complexity. Interestingly, table 3 shows that younger people actually think in *more* cognitively complex patterns about the financial crisis. The lack of moderation effects for TV and online news might also simply be due to less statistical power (i.e., a majority of content analyzed news was from newspapers; table 1). Experimental designs that keep content as stable as possible and only manipulate the presentation format (e.g., Kruikemeier, Lecheler, and Boyer 2017) are needed to verify these assumptions and disentangle how the demonstrated effects are conditional upon modality.

Reflecting on the generalizability of our findings, the Netherlands is rather typical for the northern European region regarding both education and media landscape: Higher education is relatively accessible to all income categories, and the country has a popular public broadcaster and strong newspaper market that set a high standard for other news outlets (Brants and Van Praag 2006). The impact of issue-relevant news exposure on cognitive complexity could

4. See https://osf.io/5xcrv/?view_only=2972642f46804a609653589ad9455823.

perhaps be more impactful in countries with a lower-educated population. Alternatively, the relationship could be weaker in countries with media systems that are dominated by TV, tabloids, or commercially oriented outlets. Under those circumstances, citizens will be less likely to come across news of sufficient quality to increase their level of cognitive complexity. Overall, the current study suggests that exposure to issue-relevant news plays an enhancing role in the political empowerment of citizens: Cognitive complexity was higher among lower-educated citizens who were exposed to more news about the financial crisis. However, for many of them this effect is canceled out because general news consumption had a negative effect. Thus, the mix matters: The cognitive complexity of lower-educated citizens will only increase when these people consume more news from outlets that devote a relatively large proportion of their total coverage to the specific topic.

Appendix A. Multiple-Choice Questions to Measure Factual Knowledge

Survey wave	Question	Answer	% correct
1	Looking at the current interest rates on savings accounts or mortgages, is this interest currently lower than normal, higher than normal, or average?	Lower than normal	95.3
1	Who is the Dutch Minister of Finance?	Jeroen Dijsselbloem	88.9
1	Who is the current director of the International Monetary Fund (IMF)?	Christine Lagarde	77.6
1	Which of the following countries is not one of the 5 most important European trading partners of the Netherlands?	Spain	58.5
1	What is the creditworthiness of the Netherlands according to assessors Fitch and Moody's?	AAA	52.0
2	What is TTIP?	Free trade agreement between the US and EU	61.6
2	Which government-owned bank came into disrepute due to the bonuses of their directors?	ABN Amro	92.5
2	Which law was approved by Parliament that directly influences Dutch employees?	Allowing flexible working times	59.9
3	Which semi-public corporation did Timo Huges work for before he resigned after problems with public procurements?	NS Dutch Railways	78.6
3	What is the percentage of economic growth predicted by the Dutch National Bank?	2 percent	56.9
3	What is the name of the Greek Minister of Finance?	Yanis Varoufakis	74.7

NOTE.— Questions were inspired by the survey of [Kalogeropoulos, Albæk, et al. \(2015\)](#).

Appendix B. List of 47 Predefined Concepts to Create the Cognitive Maps

Banking world
Breaking up the EU
Businesses
Competitiveness of the Netherlands
Democracy
Dutch consumers
Dutch interests
Dutch politics
Economic growth
Efficiency
Employment
Enlargement of the EU
Environmental protection
Equality
Europe
European identity
European leadership
European subsidies
Financial crisis
Financial stability
Free trade
Freedom
General interest
Globalisation
Government expenses
Greece leaving the EU (Grexit)
Having the Euro as currency
Housing market
Immigration
Inflation
Media
More empowerment of the EU
Netherlands leaving the EU (Nexit)
Peace
Personal financial situation
Political stability
Public support for EU
Regulation
Security
Social justice
Social security
Solidarity
Sovereignty of the Netherlands
Trade
Uncertainty
Voice in decision making
Welfare

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