Research article

The evaluation of fake and true news: on the role of intelligence, personality, interpersonal trust, ideological attitudes, and news consumption

Cornelia Sindermann [a,*], Helena Sophia Schmitt [a], Dmitri Rozgonjuk [a,b], Jon D. Elhai [c], Christian Montag [a]

[a] *Department of Molecular Psychology, Institute of Psychology and Education, Ulm University, 89081 Ulm, Germany*
[b] *Institute of Mathematics and Statistics, University of Tartu, Tartu, Estonia*
[c] *Department of Psychology, and Department of Psychiatry, University of Toledo, Toledo, OH, USA*

ABSTRACT

Individual differences in cognitive abilities and personality help to understand individual differences in various human behaviors. Previous work investigated individual characteristics in light of believing (i.e., misclassifying) fake news. However, only little is known about the misclassification of true news as fake, although it appears equally important to correctly identify fake and true news for unbiased belief formation. An online study with $N = 530$ ($n = 396$ men) participants was conducted to investigate performance in a Fake and True News Test in association with i) performance in fluid and crystallized intelligence tests and the Big Five Inventory, and ii) news consumption as a mediating variable between individual characteristics and performance in the Fake and True News Test. Results showed that fluid intelligence was negatively correlated with believing fake news (the association did not remain significant in a regression model); crystallized intelligence was negatively linked to misclassifying true news. Extraversion was negatively and crystallized intelligence was positively associated with fake and true news discernment. The number of different news sources consumed correlated negatively with misclassifying true news and positively with fake and true news discernment. However, no meaningful mediation effect of news consumption was observed. Only interpersonal trust was negatively related to misclassifying both fake and true news as well as positively related to news discernment. The present findings reveal that underlying factors of believing fake news and misclassifying true news are mostly different. Strategies that might help to improve the abilities to identify both fake and true news based on the present findings are discussed.

1. Introduction

In modern society, threats emerging from fake news are heavily debated. To improve the understanding of proneness to these threats, it seems crucial to identify factors underlying tendencies to believe fake news (i.e., misclassify them as true) and tendencies to disbelieve true news (i.e., misclassify them as fake). The aim of the current study was to explore underlying factors associated with the aforementioned tendencies from a differential psychological perspective. Specifically, the first aim was to clarify whether individual characteristics (ability and non-ability factors) are associated with tendencies to misclassify both fake and true news (Research Objective 1). The second aim was to investigate the role of news consumption habits in light of misclassifying both fake and true news by

means of a process-model approach. More precisely, the aim was to test whether personal characteristics are associated with misclassifying both fake and true news via different news consumption habits (Research Objective 2). In doing so, the present study follows the overarching aim to examine mechanisms underlying the tendencies to misclassify both fake and true news, which have not been investigated before. The knowledge derived from this work might help to create new measures teaching susceptible individuals how to discern true and fake news.

1.1. General introduction into the topic of fake news

The term "fake news" became well-known since the US presidential elections in 2016. There is still an ongoing debate about whether fake

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news items were (intentionally) spread to influence voting decisions and to what extent fake news actually influenced the election outcome (Allcott and Gentzkow, 2017; Bovet and Makse, 2019; Dougherty, 2016; Gunther et al., 2018; Parkinson, 2016; Roberts, 2017; Solon, 2016). Similarly, fake news is discussed as a putative weapon by opinion leaders, fifth columnists, and certain politicians to direct opinions of (certain) citizens in a specific direction that aligns with the creators' aims (Singer and Brooking, 2019). Accordingly, the topic of fake news has gained increasing attention in many countries, such as the US, Greece, Italy, the UK, and Germany (Directorate-General for Communication, 2018; Stadler, 2019; Steinert, 2018; Stöber and Frumkina, 2020; Zimmermann and Kohring, 2020).

Based on a review of various definitions, Egelhofer and Lecheler (2019) conclude that information needs to show the following characteristics to be classified as fake news: i) low facticity, ii) creation with the intention to deceive, and iii) presentation in a journalistic format (the present definition refers to fake news *as genre*). Recent studies additionally highlight the implausibility of fake versus true news (Pennycook & Rand, 2019, 2020).

In particular, fake news items with political content are seen as a serious threat to democratic voting systems. According to Kuklinski et al. (2000), citizens of a democracy should be able i) to access factual information to evaluate public policies and ii) to build their preferences upon this factual information. Fake news, however, undermines these criteria. Due to the (known) availability of fake news, citizens might believe incorrect claims and/or not believe valid information anymore. Research shows that there is individual variation in (in-)correctly classifying both fake and true news (Bronstein et al., 2019; Pennycook & Rand, 2019, 2020). While several individual characteristics underlying the ability to correctly classify fake news are known (Bronstein et al., 2019; Pennycook & Rand, 2019, 2020), little is known about the ability to correctly classify true news. In order to accurately build one's attitudes and preferences, both correctly classifying fake and true news is relevant. Therefore, it is important to conduct research covering underlying factors of the (in-)abilities to correctly classify both fake and true news.

1.2. Research objective 1: associations of tendencies to misclassify fake and true news with ability and non-ability variables

Previous studies on associations between individual characteristics and tendencies to believe (i.e., misclassify) fake news emphasize the protective role of the propensity to think analytically versus intuitively – as measured by the cognitive reflection test (Frederick, 2005). However, this factor does not seem to be strongly related to tendencies to disbelieve (i.e., misclassify) true news (Bago et al., 2020; Pennycook & Rand, 2019, 2020).

1.2.1. Associations of tendencies to misclassify fake and true news with intelligence

Given these findings, it seems highly interesting to further investigate cognitive abilities in light of tendencies to believe fake news as well as to disbelieve true news. A starting point for these investigations might be the prominent theory of fluid (gf) and crystallized (gc) intelligence (Brown, 2016; Hebb, 1942), which constitutes two important components of intelligence (Cattell, 1943, 1963, 1987). Both fluid and crystallized intelligence are in some form included in different models of intelligence such as the initial gf-gc theory (Cattell, 1943), Cattell-Horn gf-gc theory (Horn and Blankson, 2005; Horn and Noll, 1997), and Carroll's three-stratum theory (Carroll, 1993, 1997) as well as their integration – the Cattell-Horn-Carroll (CHC) theory (McGrew, 2005).

According to CHC theory, fluid intelligence among others includes sequential/deductive (start with given rule, etc. and find a solution to a new problem) and inductive reasoning (discover underlying rules, etc.) (Flanagan, 2008). Interestingly, fluid intelligence has been repeatedly found to have a positive correlation with cognitive reflection (Corgnet et al., 2016; Missier et al., 2012; Primi et al., 2016; Sobkow et al., 2020).

However, while cognitive reflection can be deemed a general thinking style/tendency (Frederick, 2005), fluid intelligence is usually understood as the optimal/maximum performance one is able to show (Sobkow et al., 2020; see also the following measure: The International Cognitive Resource Team, 2014). Hence, one could argue that positive associations between performance in fake news classification tasks and analytical thinking may reflect the extent to which one heuristically arrives at a decision on the classification. Associations with fluid intelligence, on the other hand, might more likely reflect an individual's maximum ability/performance and how it is related to performance in the classification of fake and/or true news. Therefore, it seems to be of high relevance to investigate maximum performance, i.e., fluid intelligence, in light of fake and/or true news classification performance. Fluid intelligence might be negatively associated with tendencies to believe fake news, putatively by facilitating detection of implausible information in fake news (Pennycook & Rand, 2019, 2020). Additionally, this ability might also lead to lower tendencies to disbelieve true news.

Crystallized intelligence is mostly defined as "breadth and depth of a person's acquired knowledge of a culture" (Flanagan, 2008, p. 373). According to CHC theory, it comprises among others lexical knowledge, general information, and information on culture. In line with this, it is oftentimes operationalized by means of tests on (culture-specific) declarative knowledge (Flanagan, 2008; Schipolowski et al., 2014; Steger et al., 2019). Given this definition and operationalization, it is reasonable to assume that individuals with higher scores in crystallized intelligence might be less likely to believe fake news and to disbelieve true news. Knowledge about culturally and locally relevant information might help to identify fake news items since the information included in these items does not fit with previously acquired knowledge. Moreover, culture specific knowledge might also be positively associated with correctly classifying true news due to familiarity and overlap of the content with previously acquired knowledge.

Despite these theoretical considerations based on previous literature, research on direct, bivariate associations of both fluid and crystallized intelligence with misclassifying fake and true news is – to the best of our knowledge – scarce. This research gap built the rationale for investigation of these associations in the present study.

1.2.2. Associations of tendencies to misclassify fake and true news with personality

Also, putative associations of non-ability traits, such as personality, with tendencies to believe fake news and to disbelieve true news were of interest in the present research project. One of the most prominent models of personality is the Five-Factor Model. According to this hierarchical model, personality – on the highest level – can be described based on five broad domains (Fiske, 1949). Oftentimes, these domains are labelled the Big Five personality traits including Openness (to Experience), Conscientiousness, Extraversion, Agreeableness, and Neuroticism (Goldberg, 1990; Rammstedt and Danner, 2017; Tupes and Christal, 1992). These traits have been associated with a range of different variables such as believing (false) rumors (Lai et al., 2020) and fake news (Wolverton and Stevens, 2019)[1]. Of special interest in light of fake news is Openness. High scores on this trait describe individuals being imaginative, open to new ideas, arts, and aesthetics, therefore, potentially also for news/information on various topics (Rammstedt and Danner, 2017; Sindermann et al., 2020b). Bronstein et al. (2019) found that tendencies to believe fake news were negatively related to actively open-minded thinking. This construct describes the reliance on evidence as well as consideration of alternative explanations when forming and

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[1] This study should be seen as preliminary given methodological issues such as a small sample recruited via snowballing technique and a very short Big Five measure. Nevertheless, results indicate negative associations of Extraversion, Agreeableness, Openness, and Conscientiousness with tendencies to believe fake news (Wolverton & Stevens, 2019).

revising beliefs (Bronstein et al., 2019). A composite score of actively open-minded thinking is built among others including items of a personality questionnaire assessing facets of Openness (Stanovich and West, 1997). Therefore, also the personality trait Openness might be negatively associated with tendencies to believe fake news. However, a meta-analysis on conspiracy beliefs found that neither Openness nor any other Big Five domain was significantly associated with conspiracy beliefs (Goreis and Voracek, 2019); and conspiracy beliefs seem to be positively associated with believing fake news (Halpern et al., 2019).

In sum, it is highly necessary to clarify whether personality factors are associated with believing and/or disbelieving fake and true news. Aside from the hypothesis on a negative association between misclassifying fake news and Openness, the investigation of associations of both fake and true news misclassification with the Big Five was exploratory.

1.3. Research objective 2: the role of news consumption in tendencies to misclassify fake and true news

A variable, which has also not been studied in the context of tendencies to believe fake news or disbelieve true news, is news consumption. According to the model by Schwarz et al. (2016), among others the amount of supporting evidence is important for an individual to evaluate the accuracy of an information. However, it is questionable to what extent individuals are able to correctly judge on the amount of supporting evidence when they are confronted with a news item. It is proposed that individuals consuming various different news sources should be validly informed about recent news from various fields; see for example negative association between media diversity and risk to end up in an echo chamber (Dubois and Blank, 2018). Hence, consumption of various different news sources was used as a proxy for being broadly informed about recent news. Therefore, individuals consuming a greater number of news sources should be able to validly judge on the amount of supporting evidence of information, i.e., news, by not having heard of the information at all (fake news) or by having heard of the information from several different news sources before (true news). On the contrary, individuals consuming less different news sources, or no news at all, are likely to not being able to accurately judge on the supporting evidence of information from a broad field of topics, therefore, having trouble correctly classifying fake and true news.

Next to the putative negative association between number of news sources consumed and misclassifying fake and true news, it is important to investigate which personal characteristics might be associated with one's news consumption habits, i.e., the number of news sources consumed. In this way it can be clarified who, with respect to individual characteristics, consumes more or less different news sources and is less or more likely to believe fake news and disbelieve true news, accordingly. Hence, another aim of the study was to investigate models including effects of personal characteristics on performance in fake and true news (mis-)classification mediated by news consumption.

A previous study found that Openness of the Big Five was positively associated with having used TV and the Internet to consume news within the past seven days (versus not having used it). Agreeableness was positively associated with having watched news on TV and Extraversion with reading newspapers (Gerber et al., 2011). Another study reported positive associations between Openness and hours spent consuming news (Jordan et al., 2015). In another recent study it was found that next to age and gender, Openness was positively associated with the number of different news sources consumed; the ideological attitude of Right-Wing Authoritarianism (RWA) was negatively associated with the number of different news sources consumed (Sindermann et al., 2020b). High scores in RWA describe individuals who adhere to conventional values, are submissive to authorities, and show aggression towards individuals who violate conventional values and to individuals who are punished by authorities (Adorno et al., 1950; Aichholzer and Zeglovits, 2015; Altemeyer, 1996). According to the dual-process motivational model by Duckitt and Sibley (2010), RWA is only one of two dimensions explaining

various sociopolitical outcomes. The other dimension is Social Dominance Orientation (SDO) originally introduced by Pratto et al. (1994). SDO assesses to what extent an individual prefers social hierarchies over equality (Pratto et al., 1994).

In addition to replicating previous findings (e.g., the associations of Openness and RWA with news consumption), the aim of this work was to advance this line of research by studying links with SDO. Additionally, it was aimed at investigating whether the number of different news sources consumed would be a mediator variable in the associations between personality traits/ideological attitudes and tendencies to believe fake news/disbelieve true news. Aside from the proposed negative associations between number of news sources consumed and misclassifying both fake and true news and aside from the aforementioned associations of Openness and RWA with the number of news sources consumed, the investigation of these associations was exploratory.

Lastly, trust should be investigated. A recent study indicates that trust in traditional news media and politics is negatively associated with tendencies to believe fake news (Zimmermann and Kohring, 2020). With the present study, not only can these findings be replicated with another trust measure. Besides, the results can be expanded to tendencies to disbelieve true news. Additionally, a putative mediating effect in these associations via the number of different news sources consumed can be investigated. It seems likely that individuals who do not trust news media do not consume that many different news sources and, therefore, perform worse in classifying fake and true news.

For reasons of completeness, also fluid and crystallized intelligence were investigated. Both were expected to be negatively associated with tendencies to believe fake news and to disbelieve true news (see Research Objective 1); putatively via the number of different news sources consumed.

1.4. Summary of aims of the present study

In sum, the present study followed two major aims. Firstly, it was aimed at further investigating tendencies to misclassify fake and true news with a focus on ability and non-ability variables (Research Objective 1). It was hypothesized that both fluid and crystallized intelligence would be negatively associated with tendencies to misclassify fake and true news. Regarding personality, a negative association between Openness and tendencies to misclassify fake news was hypothesized.

The second aim of the present study was to investigate individuals' news consumption habits in light of tendencies to misclassify fake and true news (Research Objective 2). It was not only of interest to investigate bivariate associations of news consumption with the aforementioned tendencies. Beyond that, mediation effects of news consumption in the relations of individual differences in personality/ideological attitudes/trust with fake and true news misclassification were of interest. RWA (negatively) and Openness (positively) were hypothesized to be associated with the number of news sources consumed, which in turn was hypothesized to be negatively correlated with tendencies to misclassify both fake and true news. All other associations were investigated in an exploratory manner.

Of note, in the preregistration of this study (Sindermann and Montag, 2018) many more/different hypotheses regarding potential associations have been mentioned. However, given recent literature published following the preregistration, the hypotheses were partly updated (see also Supplementary Material I for a more thorough explanation of deviations from the preregistration).

2. Materials & methods

2.1. Open practices: preregistration, data, and material

The research project was preregistered at the Open Science Framework (OSF) (Sindermann and Montag, 2018; see further information at the end of the manuscript). Given various reasons explained in detail in

Supplementary Material I, the methods applied in the present manuscript deviate from the preregistration. Deviations are mentioned and justified in the manuscript and/or Supplementary Material I. Moreover, it is important to note that all research questions with a focus on misclassifying fake and true news mentioned in the preregistration are discussed in the present manuscript. Data, data analysis script, and material are available alongside the preregistration at the OSF.

2.2. Procedure, ethics, and participants

The study was advertised via various online as well as offline methods (see Supplementary Material II). The sample was a convenience sample since participation was allowed for anyone who was at least 18 years old (see Supplementary Material I for deviation from preregistration) and able to read and understand the German language. The study was implemented on the SurveyCoder platform (Kannen, 2018, 2020). Participation was anonymous. After completing all questionnaires and tests, participants received anonymous feedback on their scores in the tests assessing fluid and crystallized intelligence, the Big Five Inventory, and the Fake and True News Test, as an incentive.

All participants provided informed electronic consent prior to participation. The study adhered to guidelines of the German Society for Online Research (Arbeitskreis Deutscher Markt-und Sozialforschungsinstitute e. V. et al., 2007). Consultation with the local ethics committee revealed that this study was exempt from institutional review board review because data collection was anonymous and because no sensitive data (e.g., about health) were assessed.

A total of $N = 585$ participants provided data for the present study between late January and early February 2020 (see Supplementary Material I for deviations from the preregistration). After data cleaning (see Supplementary Material II), a final sample of $N = 530$ participants remained ($n = 396$ men, $n = 130$ women, $n = 4$ non-binary). The mean age of this sample was 41.82 years ($SD = 13.07$) with a range from 18 to 78 years. Most participants reported a university degree (German: "Hochschulabschluss", $n = 259$) or A-level/High school diploma (German: "Abitur", $n = 122$) as their highest educational degree. Most participants reported being employed ($n = 339$).

2.3. Measures

2.3.1. Fake and True News Test

Participants were presented a total of 32 news headlines, each consisting of a short bold-font headline and a more specific sub-headline, in random order. No pictures were presented alongside the headlines. Of the news headlines, 16 included incorrect (not 100% accurate) information (fake news), whereas the other 16 contained fully accurate information (true news). Detailed information on the selection and creation/phrasing of news items is presented in Supplementary Material III and all news headlines are uploaded at the Open Science Framework (Sindermann and Schmitt, 2020). The fake and true news headlines dealt with various topics such as national and international politics, economics, health, climate, and celebrities and were not overall biased in a particular (political) direction. Three true news headlines were excluded from final analyses (see Supplementary Material III for further explanations). This led to a final set of 16 fake news headlines and 13 true news headlines.

Participants had to indicate whether they thought each headline was fake (i.e., not 100% correct) or true (100% correct). To reflect tendencies to believe fake news, the number of misclassified fake news headlines as true was computed (McDonald's Omega: .39). Tendencies to disbelieve true news were measured by the number of misclassified true news headlines as fake (McDonald's Omega: .55). Rather low McDonald's Omegas might be explained by the variety of topics the headlines dealt with. Moreover, a news discernment score was calculated as the z-score of the accurately classified true news headlines minus the z-score of misclassified fake news headlines ("hits"–"false alarms") based on previous work (Pennycook & Rand, 2019, 2020). This score indicates resilience against effects of fake news (see Supplementary Material I for deviations from the preregistration).

2.3.2. Short Scale on Social Desirability – Gamma

As a potential confounding factor, the Short Scale on Social Desirability – Gamma (KSE-G; abbreviation based on German original name of the scale) (Kemper et al., 2012) was assessed. It comprises six items and two scales with three items each. The scales are labelled Positive Qualities Exaggeration and Negative Qualities Understatement. Each item is responded to on a 5-point rating scale ranging from 1 = "doesn't apply at all" to 5 = "applies completely". Originally, the scale ranges from 0 to 4; but since all other response scales in this study were rated beginning with 1, this scale was coded accordingly. High scores on each scale indicate higher socially desirable responding. Internal consistency estimates (McDonald's Omegas) were .51 and .62 for Positive Qualities Exaggeration and Negative Qualities Understatement, respectively; these are acceptable given the small number of items per scale.

2.3.3. Research objective 1

2.3.3.1. International Cognitive Ability Resource Project.
Fluid intelligence was measured with ten items derived from the International Cognitive Ability Resource (ICAR) project (The International Cognitive Resource Team, 2014). The items were presented in random order and there was no time restriction for answering the items. The instructions were translated into German by the bilingual research team by means of a rigorous forward- and backward-translation procedure. Discrepancies were discussed and resolved to receive the final set of German items. Two of the number series, two of the letter series, two matrix reasoning items, two progressive matrices, and two three-dimensional rotation items were randomly selected for the present study. For each item participants had to choose the correct one out of six (two matrix reasoning items) or out of eight response options (eight remaining items). The accuracy across items was calculated as the sum of correct responses and could range between 0 and 10. McDonald's Omega was .66; taking into account the variety in the tasks, this score is adequate.

2.3.3.2. Short Version of the Berlin test of Crystallized Intelligence.
The Short Version of the Berlin Test of Crystallized Intelligence (BEFKI GC-K; abbreviation based on the original German name) was applied to measure crystallized intelligence (Schipolowski et al., 2014). The test comprises 12 items assessing knowledge in 12 domains such as medicine, religion, art, and finances. For each item participants had to choose the correct one out of four response options. Participants had 5 minutes to respond to the items. Accuracy was assessed across items by calculating a sum score of correct responses ranging from 0 to 12. McDonald's Omega was .47; the rather low reliability might be due to the fact that knowledge on different topics was assessed.

2.3.3.3. Big Five Inventory.
To assess individual differences in the Big Five personality traits, the German version of the Big Five Inventory (BFI) was used (Rammstedt and Danner, 2017). The additional 45th item unique to the German version of the BFI was not included in the present analyses to enable closer comparability with other studies. Items of this questionnaire are answered on a 5-point rating scale ranging from 1 = "very inapplicable" to 5 = "very applicable". Mean values were calculated for each broad Big Five domain (taking into account recoding of several items). Internal consistency estimates (McDonald's Omegas) were .81, .83, .89, .71, .85 for Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism, respectively.

2.3.4. Research objective 2

2.3.4.1. Number of different news sources consumed.
The total number of different news sources consumed was assessed for the past six months prior to participation in the present study. Specifically, participants were first asked whether they consumed news via specific channels (yes versus no). If they stated to do so, they were further asked about how many different news sources they consumed via each of these channels within the six months prior to participation. The following channels were assessed: TV, print, radio, online news websites, Facebook's news feed, the news feeds of other social media platforms, smartphone news applications, online news aggregators, and podcasts. Across all nine news channels possibly being used by a participant (see list above), the total number of news sources a participant consumed during the past six months was calculated as the sum score. In contrast to the preregistration, groups of different news consumption habits could not be formed; see Supplementary Material I for an explanation.

2.3.4.2. Short Scale on Authoritarianism.
RWA was assessed using the Short Scale on Authoritarianism (KSA-3; abbreviation based on the original German name) (Beierlein et al., 2014). The scale comprises nine items answered on a 5-point rating scale ranging from 1 = "strongly disagree" to 5 = "strongly agree". Next to a total score, the scores of three subscales, each comprising three items, can be calculated. These scales are labeled Authoritarian Aggression, Authoritarian Submissiveness, and Conventionalism. For the present study, mean scores across the respective items of all (sub-)scales were calculated. McDonald's Omegas were .83 for the total scale and .76, .74, .74 for Authoritarian Aggression, Authoritarian Submissiveness, and Conventionalism, respectively.

2.3.4.3. Social Dominance Orientation.
The Social Dominance Orientation (SDO) scale originally published by Pratto et al. (1994) was used in German language. In more detail, the German version (Six, Wolfradt and Zick (2001) as cited in Mortal (2011)) was revised to more closely align to the original English version of the scale. All of the 16 items of the scale are answered on a 7-point rating scale from 1 = "very negative" to 7 = "very positive". A mean score across all items (taking into account recoding of several items) was calculated in the present study. The internal consistency (McDonald's Omega) of the scale was .90.

2.3.4.4. Interpersonal Trust Scale.
A German version of the Interpersonal Trust Scale (IPTS) originally developed by Rotter (1967) was used in the present study (Petermann, 1996). The scale comprises 25 items measuring trust in various entities. Each item is answered on a 5-point rating scale from 1 = "strongly disagree" to 5 = "strongly agree". The scale has been criticized frequently and its factorial structure differs between studies (Chun and Campbell, 1974; Kaplan, 1973; Rotter, 1967; Wright and Tedeschi, 1975). Nevertheless, it was used based on its items comprising trust in the news media and politics. In the preregistration it was indicated that the subscales as proposed by Chun and Campbell (1974) would be used in the present study. However, inspecting the structure of the IPTS in the present sample led to another approach. In detail, a Principal Component Analysis revealed seven eigenvalues above 1 (with one eigenvalue of 5.54 and six from 1.02 to 1.97). A scree plot pointed towards a one-component solution. Therefore, a one component structure was applied in the present work and a mean score across 21 items was computed (taking into account recoding of several items): of importance, four items were excluded (items 03, 12, 18, 25) because they loaded only weakly ($< |.30|$) on the component. The internal consistency (McDonald's Omega) of the final shortened IPTS scale was .85.

2.4. Statistical analysis

The statistical software R version 3.5.2 (R Core Team, 2018) and R studio version 1.1.463 (RStudio Team, 2015) were used for data cleaning and analysis. Information on packages and functions used can be found in the data analysis script uploaded at the OSF project website (Fox et al., 2020; Fox and Weisberg, 2019; Harrell & with contributions from Charles Dupont and many others, 2019; Hebbali, 2020; Kim, 2015; Lüdecke, 2020; Navarro, 2015; Peters, 2017; Revelle, 2018; Wickham, 2020; Wickham et al., 2019a; Wickham et al., 2019b). Regarding the scales of main interest, only the distribution of the BEFKI GC-K, the KSA-3 Conventionalism and SDO scales (and the number of news sources consumed in men) showed a skewness and kurtosis exceeding +/- 1. Therefore, the distributions of all other scale scores of main interest followed a normal distribution according to Miles and Shevlin (2001). Given the large sample size parametric tests were implemented for all analyses.

First of all, descriptive statistics and zero-order correlations between all scales of main interest were calculated (see Supplementary Material I for deviations from preregistration).

2.4.1. Potential confounding variables
Detailed information on associations between potential confounding variables and scores in the scales of main interest in the present work can be found in Supplementary Material IV; correlations of the KSE-G subscales are displayed in Table 1. The analyses led to the decision to include age, gender, education ("no university degree" versus "university degree (including university of applied sciences degree)"), and both KSE-G scales as control variables in the main analyses on Research Objectives 1 and 2.

2.4.2. Research objective 1: associations of the fake and true news test scores with ability and non-ability variables
To test associations between the three scores derived from the Fake and True News Test (misclassification of fake news, misclassification of true news, news discernment score) and intelligence as well as personality scores, three separate regression models were calculated. In each model, age, gender (only individuals indicating male or female gender identity), education, and the KSE-G subscales were included as well as the ICAR, BEFKI GC-K, and BFI scales, which were significantly associated with the respective Fake and True News Test score in the zero-order correlation analyses. Of note, education and intelligence might be confounded and social desirability might be associated with personality (see, for example, correlations in Table 1) (Bensch et al., 2019). Therefore, also models excluding education and KSE-G subscales were calculated (not preregistered). Results only changed slightly. Therefore, results obtained when these scales are not included in the analyses are only shortly summarized but the focus is on the preregistered analyses and results.

2.4.3. Research objective 2: associations of the fake and true news test scores with number of news sources consumed (including mediation models)
Mediation analyses were implemented for all constellations of putative independent, mediating, and dependent variables, whose scales correlated significantly with each other according to zero-order correlations. For all mediation models, the effects of age, gender, education, and the KSE-G scales Positive Qualities Exaggeration and Negative Qualities Understatement were partialled out from all associations. Confidence intervals for the indirect effect were bootstrapped over 1,000 samples. Variables were not standardized.

3. Results

3.1. Descriptive statistics and zero-order pearson correlations

As can be seen in Table 1, on average participants only misclassified 3.58 of the 16 fake news headlines as true and only 2.95 of the 13 true news headlines as fake. Hence, participants mostly classified fake news items as fake and true news items as true.

Table 1. Descriptive statistics and zero-order Pearson correlations.

	Total sample	Men	Women	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Number of fake news items misclassified as true	3.58 (1.84)	3.53 (1.84)	3.75 (1.83)																		
2. Number of true news items misclassified as fake	2.95 (1.98)	2.87 (1.93)	3.22 (2.12)	r = -0.13, p = .003																	
3. News discernment	0.00 (1.32)	0.07 (1.30)	-0.23 (1.35)	**r = -0.66, p < .001**	**r = -0.66, p < .001**																
4. KSE-G I	3.64 (0.57)	3.66 (0.59)	3.59 (0.54)	r = 0.05, p = .254	r = 0.01, p = .764	r = -0.05, p = .275															
5. KSE-G II	3.89 (0.75)	3.85 (0.77)	4.03 (0.65)	r = -0.12, p = .004	r = -0.01, p = .870	r = 0.10, p = .022	**r = 0.23, p < .001**														
6. ICAR	7.48 (1.93)	7.71 (1.79)	6.78 (2.17)	r = -0.09, p = .036	r = 0.01, p = .775	r = 0.06, p = .170	r = -0.01, p = .828	r = 0.00, p = .941													
7. BEFKI GC-K	10.51 (1.42)	10.62 (1.37)	10.18 (1.52)	r = -0.01, p = .777	**r = -0.20, p < .001**	**r = 0.16, p < .001**	r = 0.05, p = .237	r = 0.03, p = .535	r = 0.13, p = .004												
8. Openness	3.80 (0.60)	3.79 (0.59)	3.82 (0.63)	r = -0.04, p = .332	r = -0.02, p = .699	r = 0.04, p = .304	**r = 0.21, p < .001**	r = 0.07, p = .112	r = 0.02, p = .591	r = 0.12, p = .006											
9. Conscientiousness	3.38 (0.63)	3.35 (0.63)	3.50 (0.61)	r = 0.01, p = .882	r = -0.01, p = .744	r = 0.01, p = .893	**r = 0.25, p < .001**	r = 0.14, p = .001	r = -0.04, p = .391	r = 0.02, p = .713	r = 0.12, p = .007										
10. Extraversion	3.17 (0.81)	3.08 (0.81)	3.44 (0.75)	r = 0.09, p = .030	r = 0.04, p = .349	r = -0.10, p = .018	r = 0.12, p = .005	r = -0.04, p = .409	r = -0.14, p = .001	r = -0.05, p = .265	**r = 0.30, p < .001**	**r = 0.26, p < .001**									
11. Agreeableness	3.53 (0.51)	3.50 (0.51)	3.59 (0.53)	r = -0.03, p = .436	r = 0.02, p = .585	r = 0.01, p = .860	**r = 0.31, p < .001**	**r = 0.33, p < .001**	r = 0.00, p = .964	r = -0.03, p = .504	**r = 0.18, p < .001**	r = 0.07, p = .114	**r = 0.19, p < .001**								
12. Neuroticism	2.61 (0.73)	2.55 (0.72)	2.79 (0.74)	r = -0.03, p = .423	r = 0.02, p = .590	r = 0.01, p = .842	**r = -0.33, p < .001**	r = -0.05, p = .293	r = -0.04, p = .342	r = -0.07, p = .090	r = -0.14, p = .001	**r = -0.26, p < .001**	**r = -0.34, p < .001**	**r = -0.25, p < .001**							
13. Number of news sources consumed	20.25 (11.24)	20.52 (11.34)	19.19 (10.93)	r = 0.00, p = .974	r = -0.12, p = .008	r = 0.09, p = .041	r = 0.05, p = .288	r = -0.07, p = .135	r = 0.01, p = .834	r = 0.06, p = .143	r = 0.12, p = .004	r = -0.07, p = .115	**r = 0.16, p < .001**	r = 0.04, p = .363	r = -0.09, p = .049						
14. KSA-3 Total	1.98 (0.62)	2.00 (0.62)	1.94 (0.60)	r = 0.09, p = .039	r = 0.04, p = .349	r = -0.10, p = .023	r = 0.02, p = .728	r = -0.07, p = .096	r = -0.13, p = .003	**r = -0.27, p < .001**	**r = -0.20, p < .001**	**r = 0.17, p < .001**	r = 0.02, p = .706	r = -0.08, p = .074	r = -0.04, p = .333	r = -0.09, p = .031					
15. KSA-3 Authoritarian Aggression	2.12 (0.80)	2.15 (0.80)	2.04 (0.81)	r = 0.08, p = .062	r = 0.03, p = .558	r = -0.08, p = .063	r = 0.01, p = .906	r = -0.08, p = .068	r = -0.11, p = .012	**r = -0.25, p < .001**	**r = -0.19, p < .001**	**r = 0.17, p < .001**	r = -0.02, p = .575	r = -0.13, p = .003	r = -0.03, p = .544	r = -0.12, p = .005	**r = 0.84, p < .001**				
16. KSA-3 Authoritarian Submissiveness	1.93 (0.79)	1.94 (0.79)	1.93 (0.78)	r = 0.07, p = .085	r = 0.13, p = .003	**r = -0.15, p < .001**	r = -0.01, p = 906	r = -0.09, p = .044	r = -0.01, p = .735	**r = -0.22, p < .001**	r = -0.15, p < .001	r = 0.06, p = .151	r = 0.03, p = .541	r = -0.04, p = .345	r = -0.02, p = .593	r = -0.09, p = .035	**r = 0.80, p < .001**	**r = 0.50, p < .001**			
17. KSA-3 Conventionalism	1.90 (0.72)	1.92 (0.72)	1.85 (0.70)	r = 0.06, p = .177	r = -0.06, p = .144	r = 0.00, p = .933	r = 0.04, p = .369	r = -0.00, p = .961	**r = -0.20, p < .001**	**r = -0.16, p < .001**	**r = -0.15, p < .001**	**r = 0.18, p < .001**	r = 0.04, p = .352	r = -0.01, p = .767	r = -0.05, p = .216	r = -0.01, p = .864	**r = 0.77, p < .001**	**r = 0.50, p < .001**	**r = 0.40, p < .001**		
18. SDO	2.00 (0.78)	2.08 (0.81)	1.80 (0.65)	r = 0.07, p = .092	r = 0.02, p = .679	r = -0.07, p = .111	r = -0.05, p = .211	**r = -0.15, p < .001**	r = 0.03, p = .435	r = -0.09, p = .048	r = -0.11, p = .012	r = 0.10, p = .016	r = 0.01, p = .901	**r = -0.22, p < .001**	r = -0.04, p = .326	r = 0.03, p = .437	**r = 0.54, p < .001**	**r = 0.48, p < .001**	**r = 0.40, p < .001**	**r = 0.42, p < .001**	
19. IPTS	2.98 (0.51)	2.99 (0.51)	2.94 (0.48)	**r = -0.17, p < .001**	**r = -0.15, p < .001**	**r = 0.25, p < .001**	r = 0.07, p = .105	r = 0.14, p = .002	r = 0.08, p = .057	**r = 0.24, p < .001**	r = 0.13, p = .002	r = 0.01, p = .831	r = 0.01, p = .740	**r = 0.20, p < .001**	**r = -0.17, p < .001**	r = 0.08, p = .084	**r = -0.41, p < .001**	**r = -0.37, p < .001**	**r = -0.31, p < .001**	**r = -0.30, p < .001**	**r = -0.37, p < .001**

Note. N(total sample) = 530, *n* = 396 men, *n* = 130 women, *n* = 4 non-binary (not included in the results of men and women or as separate group due to the small number of participants in this group; they are included in the correlational analyses); KSE-G = Short Scale on Social Desirability – Gamma (I = Positive Qualities Exaggeration, II = Negative Qualities Understatement); ICAR = International Cognitive Ability Resource; BEFKI GC-K = Short Version of the Berlin Test of Crystallized Intelligence; KSA-3 = Short Scale on Authoritarianism, SDO = Social Dominance Orientation; IPTS = Interpersonal Trust Scale; *p*-values presented are not controlled for multiple testing issues but bold writing indicates correlations with significant (*p* < .05) *p*-values after Holm adjustment of *p*-values (Aickin and Gensler, 1996).

6

Regarding correlations of the three scores derived from the Fake and True News Test, results reveal that the BEFKI GC-K score was significantly related to the number of true news items misclassified as fake (negatively) and news discernment (positively) even after correcting for multiple testing. The KSA-3 Authoritarian Submissiveness score was significantly negatively related to news discernment and the IPTS score was significantly related to the number of fake news items misclassified as true (negatively) and news discernment (positively) even after correcting for multiple testing.

Of note, a graphical illustration of the most important findings regarding the Fake and True News Test results from Table 1 can be found in Supplementary Material V in Supplementary Figure 1. Moreover, scatterplots of the associations of news discernment with the BEFKI GC-K score, the KSA-3 Authoritarian Submissiveness score, and the IPTS score can be found in the Appendix.

3.2. Research objective 1: associations of the fake and true news test scores with ability and non-ability variables

Table 2 depicts the results of a regression model where the number of fake news items misclassified as true was predicted from control variables, ability (ICAR), and non-ability (Extraversion) related scores. None of the ability and non-ability related scores included in the regression model (model statistics: $F(7,518) = 3.29$, $p = .002$; adjusted $R^2 = 0.03$) significantly predicted the number of misclassified fake news items. The ICAR scale effect just failed to be statistically significant. A graphical illustration of the results can be found in Supplementary Material V in Supplementary Figure 2.

As can be seen in the regression model predicting the number of true news items misclassified as fake as shown in Table 3, aside from control variables, the number of misclassified true news items was significantly negatively predicted by the BEFKI GC-K score, only (model statistics: $F(6,519) = 9.60$, $p < .001$; adjusted $R^2 = 0.09$). This indicates that higher scores in the BEFKI GC-K are associated with a lower number of misclassified true news items. A graphical illustration of the results can be found in Supplementary Material V in Supplementary Figure 3.

Finally, Table 4 shows that news discernment was positively predicted by the BEFKI GC-K score as well as negatively by the Extraversion score (aside from effects of control variables) in a regression model (model statistics: $F(7, 518) = 8.98$, $p < .001$; adjusted $R^2 = 0.10$). Hence, higher scores in the BEFKI GC-K and lower scores in Extraversion seem to be associated with higher news discernment scores. A graphical illustration of the results can be found in Supplementary Material V in Supplementary Figure 4.

3.3. Research objective 2: associations of the fake and true news test scores with number of news sources consumed (including mediation models)

As can be seen in Table 1, the number of news sources consumed was negatively related to the number of true news items misclassified as fake and positively to the news discernment score. However, associations were only significant before the Holm correction. Taking the Holm correction into account, the bivariate associations were non-significant, and, hence, no mediation effects would need to be investigated. Therefore, results on mediation models when not taking into account the Holm correction are presented in Supplementary Material VI. However, as can be seen there, the mediation effects were mostly non-significant or very small.

4. General discussion

The aim of this study was to explore the associations of ability and non-ability related variables (Research Objective 1) as well as news consumption habits (Research Objective 2) with tendencies to believe fake news and tendencies to disbelieve true news in a German sample.

It was found that misclassifying true and fake news correlated weakly negatively ($r = -.13$, $p = .003$). Accordingly, beliefs that both true and fake news are correct, correlated positively. This weak positive association is in line with slightly higher positive correlations reported in earlier studies (Bronstein et al., 2019; Pennycook and Rand, 2020). Overall, these associations indicate that classifying true and fake news, i.e., also tendencies to believe fake news and disbelieve true news, share some variance but are mostly separable and putatively mostly different determinants underlie both tendencies.

4.1. Research objective 1: associations of tendencies to misclassify fake and true news with ability and non-ability variables

Regarding such underlying determinants of tendencies to believe fake news and disbelieve true news, it was found that most of the personality traits, hence, non-ability traits, did not play a major role in explaining either of the tendencies. Most of the Big Five traits were neither associated with misclassifying fake news as true nor with misclassifying true news as fake. This was also true for Openness, which contradicts the initial hypothesis. It is important to note that Openness can also be investigated on facet level, hence, Openness might be split into an openness and an intellect facet (DeYoung et al., 2007). Different facets might exhibit different associations with fake and true news (mis-)classifications (also see differential associations in, for example, DeYoung et al. (2012)). The questionnaire used in the present study splits Openness into Openness for aesthetics and Openness for ideas. The associations between these two facets and fake and true news misclassification were quite similar and non-significant; however, news discernment and Openness for ideas just failed to be significant: $r = 0.07$, $p = .060$ (these analyses were not preregistered).

Extraversion exhibited a significant negative association with news discernment. This association did not remain significant after correcting the zero-order correlation for multiple testing (see Table 1) but it was significant in the regression model (see Table 4). Moreover, the effect size is similar to ability related variable effect sizes. This result indicates that higher Extraversion is associated with lower abilities to discern true from fake news. A positive association of Extraversion with fake news misclassification was also found but only in the correlational analysis.

Of the ability related variables, fluid intelligence was significantly negatively associated with misclassifying fake news items as true (but only before correcting the zero-order correlation for multiple testing and not in the regression model; see Tables 1 and 2). Crystallized intelligence was negatively related to misclassifying true news items as fake (see Tables 1 and 3). These results are only partly in line with the hypotheses that both intelligence variables would negatively relate to tendencies to misclassify both fake and true news. Lastly, in addition to Extraversion (negatively) also crystallized intelligence (positively) was significantly associated with news discernment in the regression analysis (see Table 4). In sum, the results regarding crystallized intelligence indicate that individuals with higher crystallized intelligence are better in discerning fake from true news, mostly because they are better in correctly classifying true news. However, it needs to be mentioned that the effect sizes are mostly small (Cohen, 1988).

Although the negative association of fluid intelligence with tendencies to believe fake news would not hold after correction for multiple testing or in the regression model (see Tables 1 and 2), these findings may have important implications: it seems that tendencies to believe fake news need to be separated from tendencies to disbelieve true news (see weak associations between both constructs and different underlying determinants). While fluid intelligence appears to be protective against believing fake news, crystallized intelligence seems to be protective against disbelieving true news. These findings are in line with literature showing that the cognitive reflection test is strongly negatively related to believing fake news but only slightly related to disbelieving true news (Bago et al., 2020; Bronstein et al., 2019; Pennycook & Rand, 2019, 2020). As mentioned in the introduction, both factors, tendencies to

Table 2. Regression model predicting the number of fake news items misclassified as true.

	B	SE	t	p
Intercept	0.038	0.073	0.524	.601
Age	-0.058	0.045	-1.293	.197
Gender	0.105	0.105	1.004	.316
Education	-0.104	0.090	-1.157	.248
Positive Qualities Exaggeration	0.068	0.045	1.512	.131
Negative Qualities Understatement	-0.135	0.046	-2.951	.003
ICAR	-0.077	0.045	-1.717	.087
Extraversion	0.064	0.045	1.413	.158

Note. Only the ICAR, BEFKI GC-K, and BFI scales, which were significantly associated with the respective Fake and True News Test score in the zero-order correlations were included. All variables except gender and education were standardized before inclusion in the model; gender: 0 = men, 1 = women (individuals stating non-binary gender identity are not included; standardization was implemented in the men and women only sample); education: 0 = no university degree, 1 = university (of applied sciences) degree. If education and the KSE-G scales are not included, the results of age and the ICAR reach significance ($p < 0.05$).

Table 3. Regression model predicting the number of true news items misclassified as fake.

	B	SE	t	p
Intercept	0.016	0.071	0.220	.826
Age	-0.241	0.044	-5.485	<.001
Gender	0.151	0.099	1.537	.125
Education	-0.085	0.087	-0.981	.327
Positive Qualities Exaggeration	-0.000	0.043	-0.004	.997
Negative Qualities Understatement	0.029	0.044	0.655	.513
BEFKI GC-K	-0.136	0.044	-3.108	.002

Note. Only the ICAR, BEFKI GC-K, and BFI scales, which were significantly associated with the respective Fake and True News Test score in the zero-order correlations were included. All variables except gender and education were standardized before inclusion in the model; gender: 0 = men, 1 = women (individuals stating non-binary gender identity are not included; standardization was implemented in the men and women only sample); education: 0 = no university degree, 1 = university (of applied sciences) degree. If education and the KSE-G scales are not included, significances (i.e., whether they are < 0.05 or ≥ 0.05) of results do not change.

believe fake news and tendencies to disbelieve true news, are equally important threats to a fact-based belief formation. On the one hand, misclassifying fake news as true might lead to a bias in beliefs based on inaccurate claims. On the other hand, misclassifying true news as fake might as well bias beliefs because accurate claims are not processed as such and not used to form one's beliefs. In sum, only if both fake and true news can accurately be classified as fake and true, one can validly judge on the real situation and form one's beliefs on (all) available facts.

4.2. Research objective 2: the role of news consumption in tendencies to misclassify fake and true news

The number of true news items misclassified as fake (negatively) as well as news discernment (positively) were significantly associated with the number of news sources consumed. Therefore, consuming a greater number of news sources seems to buffer against misclassifying true news as fake. This might be due to the fact that well-informed individuals are able to accurately judge on the amount of supporting evidence of true news (Schwarz et al., 2016) or simply due to having heard of the true news before. Additionally, this finding further underlines the distinction between tendencies to believe fake news and tendencies to disbelieve true news. However, it needs to be noted that these correlations would not remain significant after Holm correction for multiple testing; and again, effect sizes were small (Cohen, 1988).

Regarding putative mediating effects of number of news sources consumed in the relations of personality, intelligence, ideological attitudes, and trust with misclassifying fake or true news items and news discernment, barely any effect could be observed (except for an extremely small effect on the relation between Extraversion and news discernment; see Supplementary Material VI). Future studies might want to examine moderation rather than mediation models: it is possible that

only if individuals consume a low amount of different news sources and are, therefore, less informed, heuristics must be applied to rate the correctness of an unknown news headline. Only in this case, fluid intelligence (or cognitive reflection investigated in previous studies) might be of importance when rating news. However, if one is reading many different news sources and is well informed, hence, when someone most likely knows the true news headlines in a Fake and True News Test, associations between fluid intelligence (or cognitive reflection) and performance in a Fake and True News Test might be smaller. These effects might specifically apply to rating true news (as fake news cannot be known when they are invented by scientists like in the present study).

4.3. Further findings

Zero-order correlations between the three variables derived from the Fake and True News Test and the ideological attitudes of Right-Wing Authoritarianism (RWA) and Social Dominance Orientation (SDO) as well as Interpersonal Trust were reported in Table 1. Of the ideological attitudes, only the RWA subscale Authoritarian Submissiveness was negatively associated with news discernment after correcting for multiple testing. Interpersonal trust was the only variable related to both misclassifying fake news items as true and true news items as fake. In detail, it was negatively associated with both variables and positively with news discernment with small to medium effect sizes. Associations mostly remained significant after correction of multiple testing. Although these associations were not of major interest beforehand, the associations are highlighted given their effect sizes, which were similar to the associations of the BEFKI GC-K with misclassifying true news as fake and news discernment. Additionally, as interpersonal trust is related to both tendencies to misclassify fake and true news, trust variables seem to be of special importance in the proneness versus resilience against

Table 4. Regression model predicting news discernment.

	B	SE	t	p
Intercept	-0.050	0.071	-0.701	.483
Age	0.226	0.044	5.140	<.001
Gender	-0.210	0.100	-2.098	.036
Education	0.164	0.087	1.887	.060
Positive Qualities Exaggeration	-0.046	0.044	-1.052	.293
Negative Qualities Understatement	0.079	0.044	1.786	.075
BEFKI GC-K	0.087	0.044	1.995	.047
Extraversion	-0.090	0.043	-2.075	.038

Note. Only the ICAR, BEFKI GC-K, and BFI scales, which were significantly associated with the respective Fake and True News Test score in the zero-order correlations were included. All variables except gender and education were standardized before inclusion in the model; gender: 0 = men, 1 = women (individuals stating non-binary gender identity are not included; standardization was implemented in the men and women only sample); education: 0 = no university degree, 1 = university (of applied sciences) degree. If education and the KSE-G scales are not included, significances (i.e., whether they are < 0.05 or ≥ 0.05) of results regarding variables of main interest do not change but the gender effect is not significant anymore.

misclassifying news and being biased in belief formation (but the correlational nature of the study must be acknowledged as a limitation; see below). Moreover, the associations of interpersonal trust found in the present study partly replicate and expand findings of a recent study reporting negative associations between trust in politics and traditional news media and believing fake news (Zimmermann and Kohring, 2020). Therefore, trust – and maybe also one's own trustworthiness – seem to be interesting candidates in future research on fake and true news misclassification (see, for example, Propensity to Trust Scales (Evans and Revelle, 2008)).

4.4. Limitations and future research

Some limitations of the present study need to be mentioned. First of all, differences between the final methods applied and the methods preregistered at the OSF need to be mentioned, again (see Supplementary Material I). Additionally, a relatively large number of news headlines was presented to participants at the expense of presenting i) whole articles (in line with previous studies in this field of research (Pennycook and Rand, 2019, 2020)) and ii) headlines related only to certain (e.g., political) topics. In order to avoid confounding effects of variables such as political interest, political knowledge, and political opinions, the focus was not on political headlines in the present work. Instead, the overall tendencies to believe fake news/disbelieve true news not limited to the political context were of interest. Therefore, it is also not surprising that most of the (sub-)scales assessing RWA and SDO did not correlate significantly with any variable derived from the Fake and True News Test. High scores in RWA and SDO are usually related to specific political opinions and attitudes. For example, RWA has been associated with preference for right-leaning parties (Beierlein et al., 2014; Sindermann et al., 2020b), or negative attitudes/prejudice towards immigrants in German samples (Beierlein et al., 2014). In addition, previous studies suggest that individuals tend to overrate the accuracy of news items fitting with their political opinions but underrate the accuracy of non-fitting news items (Allcott and Gentzkow, 2017; Anthony and Moulding, 2019; Bago et al., 2020; Sindermann et al., 2020a); however, this does not seem to be due to motivated reasoning (Bago et al., 2020; Pennycook and Rand, 2019; Sindermann et al., 2020a). As the focus of the present study was not on political news headlines with, for example, left- versus right-leaning content, it is not surprising that neither RWA nor SDO were strongly associated with any of the variables derived from the present Fake and True News Test. The lack of an investigation of alignment of news headlines with one's own attitudes might be seen as a limitation. Future studies might also want to take into account a rating of each headline with regard to an individual's attitude toward the content of the headline, from very negative to very positive, to control for a potential negativity bias. Next, it is important to note that the selection and phrasing of news items, although following certain criteria (see

Supplementary Material III), might still be subjective to a certain degree. Even more objective selection and phrasing of news items might be useful in future studies.

Moreover, the use of rather short measures to assess crystallized and fluid intelligence might be a limitation. These short versions were chosen based on a trade-off to increase participation by keeping the study as short as possible. However, the brevity might explain the low correlations found for the ICAR and the BEFKI GC-K. Of additional interest: when calculating separate scores for the ICAR number series, letter series, matrix reasoning, progressive matrices, and three-dimensional rotation items and correlating these with the Fake and True News Test scores (not preregistered), only the bivariate correlations between number of fake news misclassified as true and the letter series score (r = -0.09, p = .042) turned out to be significant. Hence, using a fluid intelligence test emphasizing more verbal instead of figural reasoning might lead to other results. Similarly, when aligning content of the BEFKI GC-K items with content of news headlines, the associations might be stronger. However, as each item of the BEFKI GC-K measures knowledge in a different domain, these analyses were not implemented. Other measures might be used in future studies to test this idea.

Moreover, the effect sizes found in the present study are mostly small and the unequal ratio of men to women might be seen as a limitation. Results might have looked differently if the distribution was more balanced (see also associations of gender with variables of interest; Supplementary Material IV). Next, some participants might have checked the headlines online while participating in the study, which might contribute to comparatively low error rates in misclassification scores. However, as the incentive for participation was feedback on one's own performance (among others in the Fake and True News Test) in comparison to other participants, it is unlikely that many individuals cheated. Furthermore, the present sample is not representative of the general German population and the study is of cross-sectional nature. Due to the latter fact, one cannot draw a definite conclusion about the causal relationships. Moreover, the sample together with the German-specific news headlines limit the generalizability of the present study.

5. Conclusions

In conclusion, fluid intelligence, hence, abilities such as inductive and deductive reasoning, might be protective against believing fake news. Moreover, crystallized intelligence, hence, culture-specific knowledge, as well as consuming several different news sources might be protective against disbelieving true news. Moreover, interpersonal trust seems to be protective against believing fake news and disbelieving true news and seems to help discerning fake from true news. It needs to be mentioned that effect sizes are only mild at best, but associations between the variables are meaningful. That being said, both misclassifying fake news as

true and true news as fake are dangerous due to the potential of biasing one's beliefs and attitudes. Although political fake and true news were not investigated specifically, the results might also be transferrable to the political context and, therefore, political attitudes and voting decisions.

Accordingly, the present study sheds light on putative susceptible groups, which need to be protected: individuals with lower scores in fluid and crystallized intelligence, individuals consuming news via less sources as well as individuals with lower scores in interpersonal trust seem to be slightly more vulnerable to threats arising from the availability of fake news (including disbelieving true news) and should be addressed by information campaigns. Of note, it can be seen as problematic to target people based on their intelligence in the realm of the present context for ethical reasons: such a procedure could create a stigma for certain groups. However, our findings show the necessity to design information campaigns in an easily understandable way to make sure that many individuals can profit from them.

In light of this, much of the previous literature highlights the importance of interventions to improve the recognition of fake news as such, e.g. Roozenbeek and van der Linden (2019). Clearly, this is of great importance. However, being able to correctly classify true news is important as well. The present study sheds light on ways to improve this ability: catching up on recent news via various news sources, getting informed about recent events, expanding one's culture-specific knowledge and (re-)gaining trust.

In summary, these new insights into underlying factors associated with fake as well as true news (mis-)classification might be helpful when designing future information campaigns to exert the largest effect possible.

Declarations

Author contribution statement

Cornelia Sindermann: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Christian Montag: Conceived and designed the experiments; Analyzed and interpreted the data; Wrote the paper.

Helena S. Schmitt: Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Dmitri Rozgonjuk, Jon D. Elhai: Analyzed and interpreted the data; Wrote the paper.

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Data availability statement

Data associated with this study has been deposited at Open Science Framework (OSF) at https://osf.io/5d3zk/; project website (providing preregistration, material, data): https://osf.io/hruqd/.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

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