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Title: The SciPop Scale for measuring science-related populist attitudes in surveys: Development, test, and validation

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The SciPop Scale for Measuring Science-Related Populist Attitudes in Surveys: Development, Test and Validation

Abstract

Populism typically pits *political elites* against "the virtuous people." A distinct variant of populism ("science-related populism") extends beyond politics, however, targeting *academic elites* and suggesting they ignore people's common sense and will. Individual endorsement of such worldviews ("science-related populist attitudes") has been conceptualized but not yet measured. Hence, we developed the SciPop Scale, a survey instrument to measure science-related populist attitudes. We tested 17 survey items in a first representative survey and developed an 8-item scale. We then tested German, French, and Italian versions of this scale in a second representative survey, employing confirmatory factor analysis, Item Response Theory, and external validity tests. Findings show that the SciPop Scale is a robust and reliable measure of populist demands toward science.

Keywords: populism, populist attitudes, attitudes toward science, scale development, survey research

Introduction

Citizens in many countries have adopted populist attitudes (Rovira Kaltwasser & van Hauwaert, 2020). They support ideas which challenge established elites—particularly political elites—and emphasize the will of "the people" (Mudde, 2017). Populist attitudes are expressed in social media, voting, and political decision-making (Rovira Kaltwasser, Taggart, Ochoa Espejo, & Ostiguy, 2017). Scholars and politicians have thus argued that Western democracies currently face an "age of populism" (Smith, 2018).

Populist views do not only pertain to political, but also to media, economic, and legal elites—and to actors and methods involved in the "production of truth", i.e. to science (Huber, Fesenfeld, & Bernauer, 2020). Examples are conspiracist views that "question why the experiential knowledge people gather in […] their life remains unacknowledged by experts" (Harambam & Aupers, 2015, p. 475), online users promoting "counterknowledge" over "establishment knowledge" (Ylä-Anttila, 2018, p. 359), and petitions aimed at protecting "the ordinary people" from seemingly false scientific evidence on the 5G technology, GMOs, or COVID-19 (Stanley-Becker, 2020).

Yet, such populist "anti-science sentiments" (Krämer & Klingler, 2020, p. 256) differ from a simple lack of trust in science or other forms of science-related criticism and do not represent a mere concomitant of political populism. They can be conceptualized as an expression of a distinct *science-related populism* (Mede & Schäfer, 2020). Science-related populism generally refers to the idea that "ordinary people" reject knowledge produced by "academic elites" because it is allegedly useless and ideologically biased, and instead demand that their own common sense and will should determine decisions about scientists' research agendas, funding, and, ultimately, the "production of truth" (Mede & Schäfer, 2020, p. 484).

Like political populism (Mudde & Rovira Kaltwasser, 2018, p. 1671), science-related populism can be analyzed among its providers ("supply-side populism") and through the attitudes of its supporters ("demand-side populism"). We are concerned with the latter here,

i.e. with individuals' *science-related populist attitudes*—and particularly with the fact that scholars of science communication and populism have not provided a measurement for them so far. Hence, we devised and tested the *SciPop Scale*, a trilingual measure to assess science-related populist attitudes in survey studies. Scale development included theory-driven item development as well as scale composition, performance, and validation analyses based on two representative surveys in Switzerland.

The Concept of Science-Related Populism

Science-related populism has been conceptualized as a set of ideas suggesting a fundamental conflict between an allegedly virtuous people and an allegedly immoral academic elite over who should be in charge of science-related decision-making and over what is deemed "true knowledge" (Mede & Schäfer, 2020). As such, science-related populism is conceptually akin to political populism, which describes a perceived antagonism between a seemingly good people and a seemingly bad political (or general) elite (Taggart, 2000). Science-related populism also touches on themes arising from scholarship on the "participatory turn," which has diagnosed increased demands for citizen or lay participation in many realms of society, including science (Lengwiler, 2008). Moreover, it relies on literature on (alternative) conceptions of knowledge and (critical) attitudes toward science, which has discussed conceptual ideas labelled "epistemological populism" (Saurette & Gunster, 2011), "I-Pistemology" (van Zoonen, 2012), or "populist knowledge" (Ylä-Anttila, 2018; for an overview see Mede & Schäfer, 2020, pp. 478–480).

[Insert Figure 1 about here]

Conceptually, science-related populism consists of four major components: A) the ordinary people, B) the academic elite, C) science-related decision-making sovereignty, and D) truth-speaking sovereignty (see Figure 1). The *ordinary people* are portrayed as a collective of citizens who are, firstly, epistemologically ordinary because their preferred form of knowledge is everyday experience, straight-forward common sense, or even authentic "gut instinct"

(Davis, 2020; Harambam & Aupers, 2015); secondly, homogenous because common sense and an allegedly shared set of experiences, values, and interests are their "common denominator" (Taggart, 2000; van Zoonen, 2012); thirdly, virtuous because common sense is considered the only legitimate way of knowing as it accounts for authentic everyday experiences and is allegedly not biased by elite interests (Saurette & Gunster, 2011). The *academic elite*, representing the supposed antagonist of the people, is understood as a collective of scientists, experts, academic institutions, and other actors who hold superior epistemic authority (Hartmann, 2004). Science-related populists perceive the academic elite as immoral because it allegedly promotes the production of useless and unauthentic scientific knowledge in the proverbial ivory tower (Krämer & Klingler, 2020), conspires with other elites (Harambam & Aupers, 2015), and follows elitist ideological agendas such as "multiculturalism" or "political correctness" (Ylä-Anttila, 2018).

Science-related populism suggests that two conflicts shape the antagonistic relationship between ordinary people and the academic elite. First, a conflict over science-related *decision-making sovereignty*, i.e. the right to make decisions on research agendas, study designs, funding allocation, or the publication and withholding of results (Bimber & Guston, 1995). Science-related populists assert that an academic elite is claiming such decision-making sovereignty fully for itself as it exclusively decides on the who, how, what, and when of scientific research. After all, they criticize that these decisions allegedly do not account for the needs of ordinary people, who should actually be in charge of them themselves (Mede & Schäfer, 2020; see also Krämer & Klingler, 2020). This leads to a situation in which academic elites are seen as illegitimate and ordinary people as legitimate decision-making sovereigns (see Figure 1). The second core conflict of science-related populism concerns *truth-speaking sovereignty*, i.e. the right to determine what is considered "true knowledge" in society (Bimber & Guston, 1995), and to put forward theories about evolution, climate change, or vaccination, for example. This perceived conflict is similar to the first one: Science-related

populism describes academic elites as illegitimate possessors of truth-speaking sovereignty who allegedly deprive the ordinary people of it—even if the people, thanks to their allegedly authentic commonsensical epistemologies, demand it legitimately (Mede & Schäfer, 2020; see also Saurette & Gunster, 2011).

Scholars of (political) populism argue that the conceptual dimensions of populism can be found in the attitudes of individuals who endorse populist ideas, and that such attitudes should therefore be measured along these dimensions (Wuttke et al., 2020). Similarly, we argue that the four conceptual themes of science-related populism occur in the attitudes of its proponents, and that science-related populist attitudes should thus be modelled as a four-dimensional construct including the following dimensions: First, *conceptions of the ordinary people*, i.e. the perception that they usually rely on common sense, share the same values and interests, and have a virtuous character. Second, *conceptions of the academic elite*, i.e. the perception that scientists and experts are immoral, produce useless knowledge, and conspire with other elites. Third, *demands for decision-making sovereignty*, i.e. claims for the people's influence on scientists' work. Fourth, *demands for truth-speaking sovereignty*, i.e. claims for the superiority of commonsensical knowledge and the inferiority of scientific knowledge.

Item Development

Attitudes toward science and science-related topics—such as trust in science, public reservations toward science, or views on the political role of science—have been analyzed with standardized as well as qualitative methods, some relying on large-scale population surveys, others on textual analysis, observational methods, or interview techniques; some working in the field, others in experimental laboratory settings (for overviews see Besley, 2013; Osborne, Simon, & Collins, 2003; Schäfer, 2012). Arguably the most prominent approach to investigating science-related attitudes is the use of surveys that examine large-scale, often nationally representative probability samples of individuals with standardized questionnaires (e.g., European Commission, 2010; Gallup, 2019; National Science Board,

2018). They have been employed in many countries and over long periods of time (Besley, 2013). We therefore chose to develop a *survey* measure for science-related populist attitudes, i.e. a scale composed of selected items reflecting the four conceptual dimensions of science-related populist attitudes.

Development of such a scale can be informed by two major research fields. First, research on public attitudes toward science, knowledge, and expertise (e.g., Bertsou & Pastorella, 2017; Nadelson et al., 2014; Prpić, 2011), and second, research on populist attitudes (e.g., Akkerman, Mudde, & Zaslove, 2014; Elchardus & Spruyt, 2016; Schulz et al., 2018). We reviewed both strands extensively, drawing on a considerable number of studies that have developed and tested survey items which touch upon phenomena related to science-related populism—for example, populist anti-intellectualism (Oliver & Rahn, 2016), reservations toward scientists (Morgan, Collins, Sparks, & Welch, 2018), or demands for public participation in science (Füchslin, Schäfer, & Metag, 2019). We also relied on results of a pretest with some of these items (online survey; $n = 173$). As the pretest sample was quite specific (77.8% female; age: $M = 22.0$, $SD = 2.7$; all respondents university students), we aimed not to over-interpret the results but distill important suggestions for item choices and modifications from them.

Below, we explain how we developed 17 items for the four conceptual dimensions of science-related populist attitudes (see Supplementary Table A1). We did not use English-language items in the survey studies (see upcoming sections) but German, French, and Italian versions, then translated them into English for this article.

Conceptions of the ordinary people. In developing items for *conceptions of the ordinary people*, we referred to research on political populism, which has devised survey items capturing the notion that populists portray ordinary people as a homogenous group of virtuous citizens (e.g., Akkerman et al., 2014). From Schulz et al.'s (2018) measurement of political populism, we adopted two items addressing peoples' virtuousness verbatim (items ppl2 and

ppl4). In addition, we adopted two items reflecting peoples' homogeneity—ppl1 from Schulz et al. (2018) and ppl5 from Akkerman et al. (2014)—but simplified the wording of ppl1 and rephrased ppl5 to apply it to scientists rather than elites in general. We also measured the perception that ordinary people are united by a collective appeal to common sense, which is an essential facet of science-related populism (Mede & Schäfer, 2020). As it was not embedded in established measurements of political populism, we devised a new item (ppl3).

Conceptions of the academic elite. Items ascertaining *conceptions of the academic elite* were derived from survey measures for anti-elitism (Castanho Silva et al., 2019; Fawzi, 2019) and attitudes toward scientists (Brossard & Nisbet, 2007; Morgan et al., 2018). A first item, adopted verbatim from the Negative Perceptions of Science Scale (Morgan et al., 2018), captured the belief that scientists are dishonest about their work (eli4). A second item addressed the idea that scientists are detached from "regular people" (eli1). In its original form, it asked whether respondents agree that "scientists know best what is good for the public" (Brossard & Nisbet, 2007, p. 47), which would indicate the absence of negative conceptions of the academic elite and, perhaps, a lower level of science-related populist attitudes. Using such a negatively worded item would compensate for (dis)agreement bias (DeVellis, 2017, pp. 116–117), so we initially adopted it verbatim. However, exploratory factor analysis (PAF estimation, Promax rotation, Kaiser criterion suggested six factors) of pretest data showed that all three negatively worded items did not perform as expected: They loaded on the same factor even though they were supposed to capture different analytical dimensions. We thus decided to avoid negative wording and reformulated the original item from Brossard and Nisbet (2007) to "Scientists don't know what's good for society." We adapted a third item from a prominent measure of political populism (Castanho Silva et al., 2019; see American National Election Study, 1972) to capture the perception that scientists only seek their personal advantage (eli2), and used it to replace another negatively worded item after the pretest. Eventually, we adopted

a fourth item from Fawzi (2019) who investigated populist attitudes toward news media, and adapted it to capture the belief that scientists conspire with other elites (eli3).

Demands for decision-making sovereignty. When operationalizing demands for science-related decision-making sovereignty, we relied on a survey which examined, among other topics, citizens' demands to have a say in shaping science policies and participate in scientific research (Schäfer et al., 2018), and adopted two items from it: one verbatim (dec2) and one with minor rephrasing (dec3). We also used an item from Schulz et al. (2018), but changed their *descriptive* wording ("People like me *have* no influence on what the government does") to *prescriptive* wording ("The people *should have* influence on the work of scientists"; dec1). This was, again, due to results of exploratory factor analysis of pretest data: They indicated that dec2 and dec3 loaded on a single factor while dec1, worded descriptively, loaded on another factor. Moreover, descriptive items addressing *demands for truth-speaking sovereignty* did not form a single stable factor either. Perhaps descriptively worded demand-items, by referring to a perceived status quo, may capture conceptions of the people or the elite rather than normative demands. Such demands are, however, a key aspect of populist ideology (Taggart, 2000). We thus revised all demand-items, including dec1, using prescriptive wording only. This approach is in line with established operationalizations of political populism (e.g., Hawkins, Riding, & Mudde, 2012). After the pretest, we derived a fourth item (dec4) from research on deference to scientific authority (Brossard & Nisbet, 2007) and technocratic attitudes (Bertsou & Pastorella, 2017), i.e. on endorsements of a powerful scientific elite.

Demands for truth-speaking sovereignty. Measures of *demands for truth-speaking sovereignty* were based on studies investigating attitudes toward science (Evans & Durant, 1995), anti-intellectualism (Eigenberger & Sealander, 2001), and, once more, political populism (Oliver & Rahn, 2016). Because of the issues with descriptively worded demand-items mentioned above, we used prescriptive wording for all of them. From Evans and Durant (1995), we adopted one item that originally captured the perception that people "depend too

much on science and not enough on faith," but rephrased it so that it referred to "common sense" instead of "faith" (tru2). We also adopted one item from Oliver and Rahn (2016) and one from Elchardus and Spruyt (2016), who had developed measures for distrust toward experts and rejection of scientific knowledge which they conceptualized as components of political populism (tru1 and tru3). Initially, we intended to use another item from Oliver and Rahn (2016), but dropped it after the pretest since it did not perform well in the factor analyses, perhaps because it was worded negatively. Eventually, we adopted an item suggesting "clear answers" to be superior to "scientific theories" from Eigenberger's and Sealander's (2001) anti-intellectualism scale (tru4).

Altogether, we adopted four items verbatim from the literature, used twelve items with adapted wording, and devised one item ourselves—thus compiling a set of 17 items, five addressing conceptions of the ordinary people, four addressing conceptions of the academic elite, four addressing demands for decision-making sovereignty, and four addressing demands for truth-speaking sovereignty (see Supplementary Table A1). We started our empirical tests with a moderate instead of a large number of survey items as we could already build on a substantial body of existing research which had already presented comprehensive survey measurements to capture political populism and developed reliable and well-established measures for attitudes toward science. In addition, our pretest gave us a first impression of item performance. We then proceeded to test the 17 items in two comprehensive survey studies using nationally representative samples of the Swiss population.

Study 1: Representative Omnibus Survey

Study set-up. German versions of the 17 items were used in a representative omnibus survey that was conducted in the German-speaking part of Switzerland in March 2019 (online panel; n = 853; age: M = 51.1, SD = 13.4; 50.1% female; 49.8% higher education). We used 5-point Likert scales (1 = "fully disagree", 5 = "fully agree") with a "don't know" response option and randomized item order. In addition to our 17 items, the omnibus survey, which was

conducted by Demoscope, one of the leading Swiss polling companies, only contained items measuring perceptions of advertising.

Analytical approach. We assumed the items would relate to four latent constructs indicating the four theoretical dimensions of science-related populist attitudes proposed in section 2. Therefore, we ran exploratory factor analyses (EFA) after finding that the survey data were highly appropriate for this procedure (KMO value = .944; Bartlett's test highly significant, $\chi^2(136) = 5460.234$, $p < .001$; no inter-item correlations > |.70|). Q-Q plots and Mardia's test (skewness: $z_{1,17} = 1682.285$, $p < .001$; kurtosis: $z_{2,17} = 18.674$, $p < .001$) suggested that multivariate normality could not be assumed, hence we used principal axis factoring instead of maximum likelihood estimation since it is more robust to nonnormality (Watson, 2017, p. 233). Moreover, principal axis factoring outperforms maximum likelihood estimation in analyses with few indicators per factor (Winter & Dodou, 2012), which was advantageous for us when applying EFA to small item sets. Throughout all EFAs, we employed oblique rotation using the Promax method as the factors are most probably correlated with each other.

Factor extraction and optimization. First, we ran an EFA with all 17 items (see Supplementary Table A3). Parallel analysis (Glorfeld, 1995; Horn, 1965) suggested extracting four factors. All items reflecting conceptions of the academic elite loaded on the first factor and all items reflecting conceptions of the ordinary people loaded on the second factor, with one item (ppl5) also loading on the first factor. All items measuring demands for decision-making sovereignty loaded on the third factor—while one (dec3) also loaded on two other factors—and all items reflecting demands for truth-speaking sovereignty loaded on the fourth factor. Main factor loadings ranged from .32 to .83 and communalities were around .60.

In a second step, we sought a more robust and unambiguous factor solution. We excluded two items with notable cross loadings (ppl5 and dec3) and obtained a pattern matrix with factors perfectly corresponding to our theoretical dimensions. After submitting the

remaining 15 items to another EFA, we dropped each factor's worst-performing item, i.e. the item with the lowest loading (ppl1, eli1, dec4, tru3). This approach yielded a parsimonious and stable factor solution (Worthington & Whittaker, 2006). To further improve the conciseness of the factor structure and avoid indicator/factor inequalities, we retained those two items per factor which formed most reliable 2-item scales (according to Spearman-Brown coefficients) and excluded all others (ppl2, eli4, tru4). This led to a final set of eight items, which again loaded on four factors representing the four conceptual dimensions (see Table 1).[1]

[Insert Table 1 about here]

Final factor solution. These final eight items loaded strongly on the four conceptually anchored, stable, and well-defined factors (see Table 1). The factors accounted for 62.47% of the overall variance (factor 1 = 16.46%; factor 2 = 14.46%; factor 3 = 15.62%, factor 4 = 15.94%; factor correlations can be found in Supplementary Table A4). Main factor loadings ranged from .71 to .78 and communalities were between .56 and .69. The pattern matrix was in line with our theoretical presumptions: Each item loaded on a factor that corresponded with the dimension we expected the item to indicate (see section 3). Accordingly, the items formed four plausible 2-item subscales: the Academic Elite Subscale, the Ordinary People Subscale, the Decision-Making Subscale, and the Truth-Speaking Subscale. Spearman-Brown coefficients (between .73 and .78) suggested that the subscales had good reliability and precisely captured one of the four conceptual components of science-related populist attitudes. These subscales form a scale that measures science-related populist attitudes in their entirety: the "SciPop Scale." When combined to a single score (see section 6), they quantify the intensity of these attitudes with a single numerical value: the "SciPop Score."

Study 2: Science Barometer Switzerland Survey

Study set-up. In a next step, we tested the SciPop Scale in three languages (German, French, Italian) using survey data from the 2019 wave of the Science Barometer Switzerland ("Wissenschaftsbarometer Schweiz"), a triennial, nationally representative population survey

(n = 1050; age: M = 48.3; SD = 17.3; 53.5% female; 47.8% tertiary education). The survey was also carried out by Demoscope and took place in June and July 2019. Demoscope's professional translators translated the items, and the research team double-checked the translations. Respondents were surveyed in computer-assisted telephone interviews (landline: 81%, numbers from public telephone listings; mobile: 19%, random digit dialing). Selection of landline respondents was based on gender and age quotas; mobile respondents were selected via random digit dialing. Administering the survey via telephone instead of online had no substantial effect on sample characteristics: Distributions of sociodemographic variables and scale item responses differed only marginally between Study 1 and Study 2 samples (see item means and standard deviations in Table 1 and Supplementary Table A6). Among other topics, the survey investigated science-related information use, attitudes toward science, and perceptions of science communication. The SciPop Scale items—again measured with 5-point Likert scales with higher values indicating agreement—were introduced as questions about the "relationship between science and society."

Analytical approach. To examine the stability of the factor structure discovered in Study 1, we performed confirmatory factor analyses (CFA). We specified four latent factors and eight indicators, each being permitted to load only on the factor with which it corresponded in the final EFA (see Table 1). For model identification and scale setting we applied an effects-coding technique known as the LSC method (Little, Slegers, & Card, 2006). Because of multivariate nonnormality (Mardia's skewness: $z_{1,8}$ = 231.632, $p < .001$; kurtosis: $z_{2,8}$ = 12.640, $p < .001$), we fitted the model using maximum likelihood estimation with robust standard errors and a Satorra-Bentler scaled test statistic. We also ran a multi-group CFA with the German, French, and Italian-language subsamples specified as groups to investigate scale performance in different languages. The multi-group CFA followed the same procedure as the single-group CFA (same model and estimation method), with the exception that we fixed the error variance of one item in two groups to zero as it was not significantly different from zero.

CFA model fit. CFA results suggested that the measurement model had good global fit (χ^2 = 22.877, *df* = 14, *p* = .062). Robust approximate fit indices met established cutoff criteria (Robust CFI = .994, Robust TLI = .988, Robust RMSEA = .027, SRMR = .017; Hu & Bentler, 1999[2]). Local model fit was also good: All factor loadings, which ranged from .454 to .952, were highly significant at the *p* = .001 level (see Supplementary Tables A6 and A7 for standardized loadings and inter-factor- correlations). The dec2 item had the lowest loading (λ = .454) which suggests that it had comparably little capacity to indicate its latent factor. Results of the multi-group CFA showed that the measurement model describes the data structures of the German, French, and Italian-language subsamples almost equally well: We found good fit (χ^2 = 37.340, *df* = 28, *p* = .112; Robust CFI = .990, Robust TLI = .969, Robust RMSEA = .044, SRMR = .027), highly significant factor loadings (each *p* < .001; see Supplementary Table A8), and configural equivalence. These findings suggest that the factor structure found in Study 1 is stable across the German, French, and Italian-language samples. This means that the SciPop Scale can be assumed to be a robust and reliable tool working well in three languages and different linguistic regions within Switzerland.

Further Tests of Item and Scale Performance

The previous analyses allowed us to identify eight survey items as powerful indicators of science-related populist attitudes (i.e., the SciPop Scale), to compose distinct subscales for the four underlying dimensions, and to demonstrate that the SciPop Scale and its subscales are robust and reliable across all three languages. But the quality of a survey scale is not only determined by its internal robustness and reliability—it also depends on the *measurement precision of its individual items* and its *external validity* (DeVellis, 2017).

Measurement precision of individual items. Factor analyses and Spearman-Brown coefficients do not capture how accurately specific scale items mirror individuals' actual attitudes, because they rely on classical test theory (CTT), which does not assume a link between respondents' actual attitudes (i.e. their latent trait levels) and the precision (i.e., the

measurement error) of items measuring these attitudes (Hambleton & Jones, 1993). In other words, CTT does not assume that a survey item may be better in measuring agreement with an attitude than rejection of an attitude, or that it may be able to capture moderate attitudes better than strong attitudes. However, these aspects are relevant in scale development (DeVellis, 2017). We therefore ran analyses based on Item Response Theory (IRT). Unlike CTT, IRT-based procedures account for the trait-error-link by means of mathematical models. These models describe the relationship between individuals' latent traits (in our case: science-related populist attitudes) and the properties of items measuring these traits (in our case: the precision of the SciPop Scale items) by estimating trait levels and item properties based on observed survey data with maximum likelihood procedures (Harwell, Baker, & Zwarts, 1988). Our analyses relied on Graded Rating Scales Models, which are appropriate for polytomous response data (Muraki, 1992), and used the Study 2 data. They offered three main insights.

[Insert Figure 2 about here]

First, we found that six out of eight items (all except ppl3 and eli2) were almost equally precise for lower and higher levels of the attitude they were supposed to measure, as can be inferred from Item Information Curves (IICs; see Figure 2). Generally, IICs illustrate how much precision ("item information" in IRT nomenclature; signified as $I(\theta)$ and displayed on the Y axis) an item has for each level of the attitude it is supposed to measure (i.e. for each latent trait level; signified as θ and displayed on the X axis). In our case, the measurement precision $I(\theta)$ of most items was approximately as high for lower trait levels ($\theta \approx -2$) as it was for higher trait levels ($\theta \approx 2$). Therefore, these items are likely to be similarly reliable for different intensities of science-related populist attitudes. This distinguishes our scale from conventional populism scales which often measure strong populist attitudes less precisely than weak populist attitudes (van Hauwaert, Schimpf, & Azevedo, 2020).

Second, we discovered that the items ppl3 ("What unites the ordinary people is that they trust their common sense in everyday life") and eli2 ("Scientists are only after their own

advantage") had slightly higher measurement imprecision. The IICs illustrate that: While ppl3 had comparably small precision $I(\theta)$ for larger trait levels θ, eli2 had comparably small precision $I(\theta)$ for smaller trait levels θ (see Figure 2). Further analyses revealed that some respondents who *did not hold the attitude* that was addressed in the ppl3 statement tended to report indifference or moderate *agreement*, whereas some respondents who *did hold* the attitude that was addressed in the eli2 statement tended to report indifference or moderate *disagreement* (see Supplementary Figure A1). This suggests that ppl3 and eli2 may be subject to minor social desirability biases. Possibly, respondents avoided admitting that they do not think that ordinary people are united by their trust in common sense (ppl3), and that they believe that scientists are only after their own advantage (eli2), because they suspected this to be less socially acceptable when participating in a scientific study.

Third, we identified minor differences between German, French, and Italian versions of the scale. Items eli2 and eli3 had relatively good precision in French but less in German (see IICs for different subsamples in Supplementary Figure A2). Meanwhile, tru2 was very precise in German but performed less well in Italian. The Italian versions of dec1 and dec2 also had less precision compared to their German and French counterparts.

Overall, these findings indicate that the items of the SciPop Scale generally perform well for different levels of science-related populist attitudes, and that the scale does not have considerable reliability imbalances. They also suggest that two items may be prone to social desirability bias, and that measurement precision varies somewhat across languages.

External validity of the SciPop Scale and its subscales. To assess the external validity of the SciPop Scale, we investigated Pearson correlations between aggregate "SciPop Scores" and constructs that were also examined in the Science Barometer Switzerland survey and are presumably associated with science-related populism. SciPop Scores were attained by using the minimum subscale mean per respondent. This takes into account that science-related populist attitudes require the concurrent presence of their four components (Wuttke et al.,

2020).[3] Associated constructs were trust in science (1 item), trust in scientists (1 item), and perceived trustworthiness of scientists (9 items), as research has shown that endorsement of political populism and political trust relate negatively to each other (Akkerman, Zaslove, & Spruyt, 2017). Since other studies have suggested a positive association of populist attitudes and negative evaluations of media reporting (Fawzi, 2019), we also investigated the relationship of science-related populist attitudes and perceived trustworthiness of science-related media coverage (1 item). Lastly, we inspected correlations of the SciPop Score with two items addressing reservations toward science and one item measuring beliefs in the promise of science (Prpić, 2011) because we assumed that science-related populism, with its anti-intellectual outlook, relates positively to the former and negatively to the latter.

Analyses indicated that correlations of the SciPop Score and related constructs were in line with expectations (see Supplementary Table A9). Respondents with high SciPop Scores tended to have lower trust in science (r = -.20, p < .001) and university scientists (r = -.26, p < .001), deem scientists to be less trustworthy (r = -.18, p < .001), think that science makes their lives change too fast (r = .25, p < .001), believe that people rely too much on science (r = .26, p < .001), and perceive science coverage as less trustworthy (r = -.17, p < .001). Correlations of the four subscales and the constructs were also plausible. However, most of them were not considerably strong. This suggests that science-related populist attitudes (or the SciPop Scale) are distinct from other unfavorable attitudes toward science (or existing measurements thereof; see Hartman, Dieckmann, Sprenger, Stastny, & DeMarree, 2017; Morgan et al., 2018; Nadelson et al., 2014).

In sum, these findings demonstrate that the SciPop Scale and its four subscales have good external validity. They indicate that the scale captures a valid construct which has significant and plausible relations to, yet is still different from, other currently discussed phenomena like skeptical attitudes toward (science) media and (dis)trust in science.

[Insert Table 2 about here]

Discussion

In this article we introduce the SciPop Scale, an 8-item survey measure to examine science-related populist attitudes—that is, the belief that an allegedly virtuous people, and not an allegedly immoral academic elite, should determine what scientists research and what societies consider "true knowledge" (see Table 2 for the final scale; see also Supplementary Tables A11-A13 for the final scale in German, French, and Italian). The SciPop Scale measures science-related populism, a phenomenon that permeates public perceptions of various scientific issues: Existing public opinion research suggests that people in several countries distrust scientific evidence on climate change, nuclear power, or GM food (e.g., Merkley, 2020) and demand their own common sense to guide decisions on how to cope with the COVID-19 pandemic, for example (Wissenschaft im Dialog, 2020). Yet, such research has not provided a full account of science-related populist attitudes: Studies on distrust toward science, for instance, do not capture the idea that people's experiences and sentiments should replace the scientific knowledge (e.g., Nadelson et al., 2014), while research on anti-intellectualism does not investigate popular demands for science-related decision-making power (e.g., Marques, Elphinstone, Critchley, & Eigenberger, 2017). Rather, these studies have analyzed phenomena that are related to, yet conceptually different from, science-related populism, which is illustrated by the comparably small correlation of respondents' SciPop Scores and their level of (dis)trust in science we found in the validity tests (r = -.20, p < .001). The SciPop Scale, however, grasps science-related populist attitudes in their entirety.

We believe the SciPop Scale may advance research on science-related populism and beyond in at least two major ways. First, survey researchers can use it to investigate the prevalence of science-related populist attitudes in various populations on the national and regional level. The scale can be employed in multiple languages and in cross-nationally comparative research, which could give insights into country-specific differences (Füchslin, 2019). The four subscales allow fine-grained insights into respondents' conceptions of

"ordinary people," "academic elites," as well as "decision-making" and "truth-speaking" demands. Furthermore, the SciPop Scale can be used to identify segments of populations that endorse or reject science-related populist attitudes more than others by examining potential predictors such as age, gender, income, education, or religiosity (Metag & Schäfer, 2018).

Second, future research may employ the SciPop Scale to explore preconditions and consequences of science-related populist attitudes. Plausible drivers (or outcomes) include political populist attitudes (Huber, 2020), conspiracy beliefs (Hameleers, 2020), distrust toward experts (Merkley, 2020), voting preferences (Motta, 2018), and cognitive reflection (Burger, Pfattheicher, & Jauch, 2020). Moreover, the role of "host ideologies" (Mudde, 2017, p. 32) like libertarianism or conservatism, which may coincide or interact with science-related populism, needs to be scrutinized empirically (Mede & Schäfer, 2020). Research efforts like these may either focus on person-level effects (e.g., decision-making processes, perhaps examined in experiments; see Huber, Fesenfeld, & Bernauer, 2020) or macro-level phenomena (e.g., societal polarization, perhaps examined in longitudinal surveys; see Gauchat, 2012), and could be especially worthwhile in the context of politicized and controversial topics like the COVID-19 pandemic, vaccination, climate change, or genetic engineering (Scheufele, 2014; see also Hartman et al., 2017).

We encourage future research to examine not only the prevalence, antecedents, and consequences of science-related populist attitudes, however, but also the reliability and validity of the SciPop Scale itself. Certain issues warrant further investigation: First, one item (dec2) had a relatively low CFA loading, suggesting that its ability to indicate respondents' demands for decision-making sovereignty was somewhat limited, especially in the German and Italian-language subsamples. Yet, we eventually stuck with the item since additional analyses did not unearth a better alternative and because a March 2020 survey with another student sample (online, n = 111; 75.7% female; age: M = 22.2, SD = 2.4) validated the original 8-item SciPop Scale once more (CFA results: χ^2 = 15.759, df = 14, p = .328; Robust

CFI = 0.987, Robust TLI = 0.974, Robust RMSEA = 0.044, SRMR = 0.056; all loadings highly significant, $p < .001$). Second, items ppl3 and eli2 may be prone to small social desirability biases. More indirect questioning could have mitigated such biases but would have diminished the verbal precision of the scale and thus its validity. Third, the SciPop Scale seems to be slightly language-sensitive as revealed in IRT-based analyses. This should be examined more thoroughly, e.g. with further measurement invariance tests similar to those performed for Schulz et al.'s (2018) populism scale (Wettstein et al., 2020), in order to decide whether item translations must be refined. Eventually, researchers working with the SciPop Scale may investigate whether a 15-item version of the scale (all items except ppl5 and dec3), which we reduced to avoid indicator/factor imbalances and accommodate researchers challenged by length restrictions in questionnaire design, performs as well as the final 8-item scale.

These minor challenges notwithstanding, the SciPop Scale is a valuable instrument which can enrich research on science-related populism and beyond. The diverse starting points for future research we proposed above illustrate that the SciPop Scale can be used to study various facets of public attitudes toward science. We thus hope that it will allow for manifold insights into the complexities of science-society-relations—insights valuable for both scholars, policy makers, and science communication practitioners.

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Footnotes

[1] Not only for the initial 17-item EFA but also for the 15-item, the 11-item, and the final 8-item EFA, Horn's (1965) parallel analyses and Glorfeld's (1995) conservative parallel analyses suggested four-factor solutions, with factor patterns conforming to the assumed dimensions, respectively. Moreover, sampling adequacy was high in each of the item sets (15-item set: KMO value = .933, Bartlett's test highly significant, $\chi^2(105) = 4861.444$, $p < .001$; 11-item set: KMO value = .902, Bartlett's test highly significant, $\chi^2(55) = 3557.327$, $p < .001$; 8-item set: KMO value = .851, Bartlett's test highly significant, $\chi^2(28) = 2373.16$, $p < .001$).

[2] Hu and Bentler (1999) proposed these cutoff criteria for uncorrected ML fit indices, but they can also be used for robust ML fit indices (Savalei, 2018, p. 424).

[3] Other aggregation procedures, such as using mean or summary scores of the full SciPop Scale as SciPop Score, would result in erroneously diagnosing the same intensity of science-related populism for respondents who endorse some components fully but reject others completely and respondents who score moderately on all components (Wuttke et al., 2020).

Table 1

Results of exploratory factor analysis with the 8 items of the SciPop Scale

			Factor 1	Factor 2	Factor 3	Factor 4	
Initial eigenvalue			4.03	1.06	0.86	0.56	
% of total variance explained after rotation			16.46	14.46	15.62	15.94	
Label	Item	*M (SD)*	$\lambda_{\text{Factor 1}}$	$\lambda_{\text{Factor 2}}$	$\lambda_{\text{Factor 3}}$	$\lambda_{\text{Factor 4}}$	h^2
ppl3	What unites the ordinary people is that they trust their common sense in everyday life.	3.29 (1.13)			.77		.63
ppl4	Ordinary people are of good and honest character.	2.87 (1.13)			.77		.59
eli2	Scientists are only after their own advantage.	2.47 (1.09)	.74				.64
eli3	Scientists are in cahoots with politics and business.	2.93 (1.21)	.78				.65
dec1	The people should have influence on the work of scientists.	2.73 (1.15)		.71			.62
dec2	People like me should be involved in decisions about the topics scientists research.	2.83 (1.15)		.78			.56
tru1	In case of doubt, one should rather trust the life experience of ordinary people than the estimations of scientists.	2.87 (1.08)				.74	.69
tru2	We should rely more on common sense and less on scientific studies.	3.25 (1.15)				.74	.61
Spearman-Brown reliability coefficient[a]			.78	.73	.75	.78	

Note. $n = 853$. Analysis based on study 1 survey data. Items measured using 5-point Likert scales with higher values indicating stronger agreement. Four factors extracted as suggested by Horn's (1965) parallel analysis and Glorfeld's (1995) conservative parallel analysis (5000 iterations, 95-percentile estimate). Extraction method: Principal Axis Factoring. Rotation method: Promax. Loadings $\lambda < |.20|$ not displayed.

[a] Cronbach's Alpha can be a useful reliability measure for 2-item scales but often underestimates their true reliability, so we relied on Spearman-Brown coefficients as these tend to be more accurate for 2-item scales (Eisinga, Grotenhuis, & Pelzer, 2013).

Table 2

Items of the final SciPop Scale

Dimension	Label	Item	Reference
Conceptions of the ordinary people	ppl3	What unites the ordinary people is that they trust their common sense in everyday life.	new
	ppl4	Ordinary people are of good and honest character.	verbatim from Schulz et al., 2018
Conceptions of the academic elite	eli2	Scientists are only after their own advantage.	adapted from the American National Election Study, 1972 (see also Castanho Silva et al., 2019)
	eli3	Scientists are in cahoots with politics and business.	adapted from Fawzi, 2019
Demands for decision-making sovereignty	dec1	The people should have influence on the work of scientists.	adapted from Schäfer et al., 2018
	dec2	People like me should be involved in decisions about the topics scientists research.	verbatim from Schäfer et al., 2018
Demands for truth-speaking sovereignty	tru1	In case of doubt, one should rather trust the life experience of ordinary people than the estimations of scientists.	adapted from Oliver & Rahn, 2016
	tru2	We should rely more on common sense and less on scientific studies.	adapted from Evans & Durant, 1995

Note. Items were measured with 5-point Likert scales ranging from 1 (“fully disagree”) to 5 (“fully agree”).

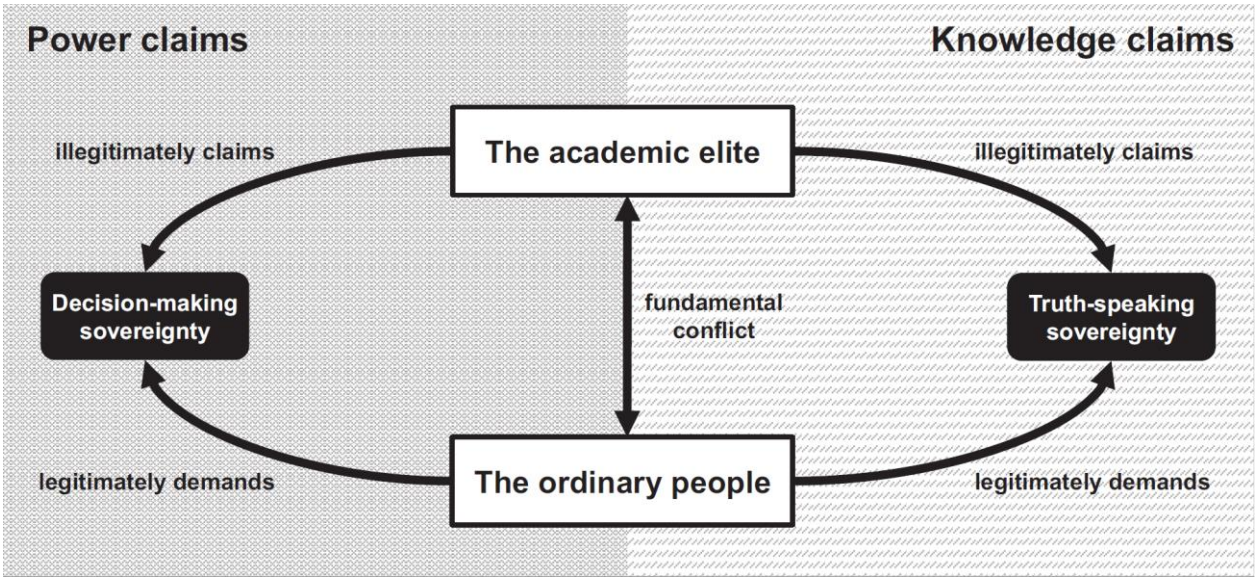


Figure 1. *Heuristic model of science-related populism (Mede & Schäfer, 2020)*

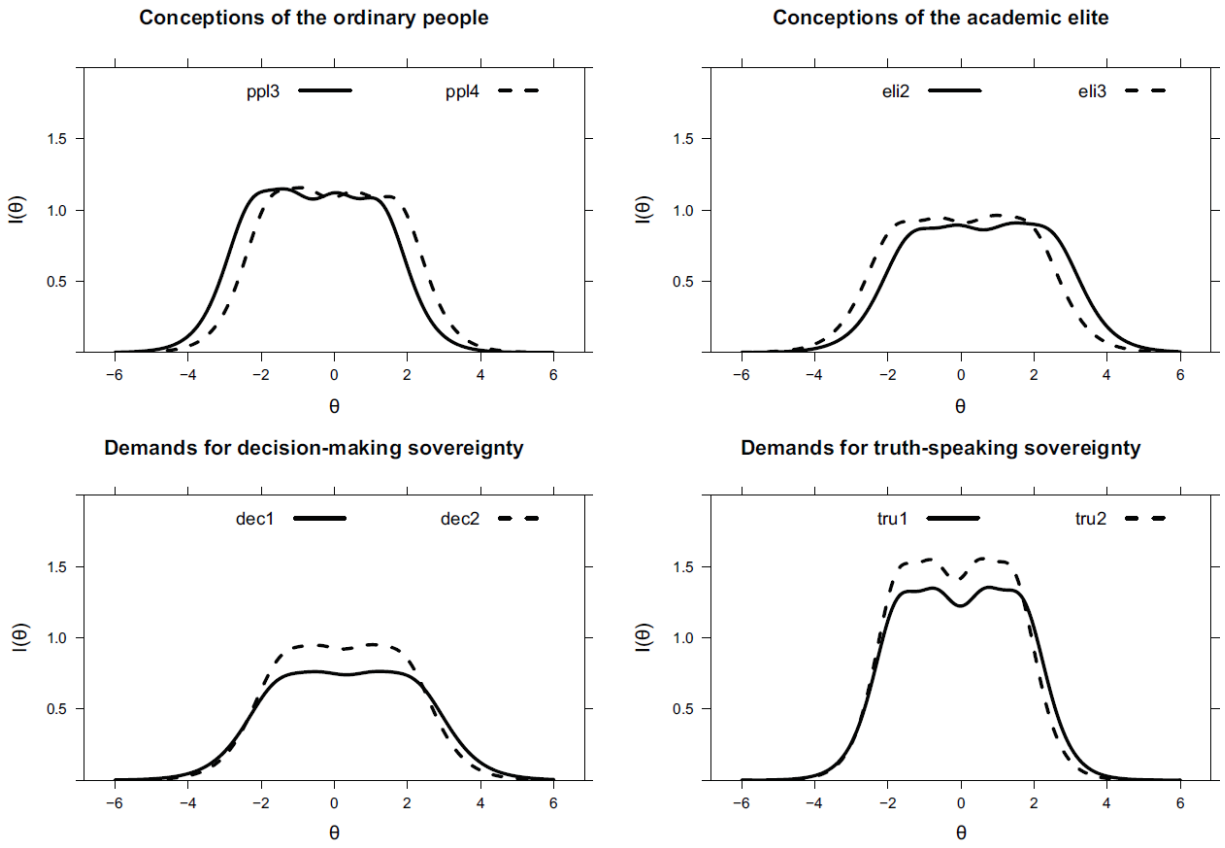


Figure 2. *Item Information Curves of the 8 items of the SciPop Scale*

Supplementary Materials

for

Mede, N. G., Schäfer, M. S., & Füchslin, T. (2021). The SciPop Scale for measuring science-related populist attitudes in surveys: Development, test, and validation. *International Journal of Public Opinion Research*, *33*(2), 273–293. doi: 10.1093/ijpor/edaa026

Contents

Introduction

In this document, we provide tables and figures supplementing the analyses presented in our research article "The SciPop Scale for measuring science-related populist attitudes in surveys: Development, test, and validation", published in the International Journal of Public Opinion Research (available at: https://doi.org/10.1093/ijpor/edaa026).

Data Handling

Although survey weights were available, we refrained from weighting the data in any of our EFAs, CFAs, and other inferential statistical analyses because weighting can skew variances, reduce standard errors, and inflate significance tests (e.g., Hibberts, Johnson, & Hudson, 2012). We did not exclude any univariate or multivariate outliers from the analyses as outlier exclusion is uncommon in scale development (e.g., Castanho Silva et al., 2019; Elchardus & Spruyt, 2016; Schulz et al., 2018), can be regarded an ethically questionable research practice (American Psychological Association, 2010, p. 12), and would not have affected the results of this particular analysis.

Model Identification

For model identification and scale setting in the confirmatory factor analyses (Supplementary Tables SA5 to SA8), we applied an effects-coding technique known as the LSC method. It was introduced by Little, Slegers, and Card (2006) as an alternative to the common approaches of imposing a unit loading identification (ULI) constraint (i.e., fixing the loading of one arbitrarily selected indicator per latent factor to 1.0) or a unit variance identification (UVI) constraint (i.e., standardizing latent factors by fixing their variances to 1.0). The LSC method suggests constraining the average unstandardized loading of the indicators of each latent factor to

equal 1.0 and the corresponding indicator intercepts to sum to zero (Little et al., 2006). The LSC method offers two main advantages compared to ULI and UVI constraint approaches: First, it enables us to test the significance of every factor loading, whereas ULI constraining allows significance tests for only four out of eight factor loadings. Second, it is compatible with multi-group CFA, which allows to compare the German, French, and Italian scale versions, whereas UVI constraining is inappropriate when running multi-group CFAs (Kline, 2011, p. 130). Importantly, fit measures of a model specified with the LSC method do not differ from fit measures of models specified by means of ULI or UVI constraints (Little et al., 2006).

Supplementary Tables

Supplementary Table SA1

Initial 17-item set (English translations for the article)

Dimension	Label	Item	Reference
Conceptions of the ordinary people	ppl1	The ordinary people think alike about important questions.	adapted from Schulz et al., 2018
	ppl2	Ordinary people share the same values and interests.	verbatim from Schulz et al., 2018
	ppl3	What unites the ordinary people is that they trust their common sense in everyday life.	new
	ppl4	Ordinary people are of good and honest character.	verbatim from Schulz et al., 2018
	ppl5	The differences between ordinary people and scientists are much greater than the differences between ordinary people.	adapted from Akkerman, Mudde, & Zaslove, 2014
Conceptions of the academic elite	eli1	Scientists don't know what's good for society.	adapted from Brossard & Nisbet, 2007
	eli2	Scientists are only after their own advantage.	adapted from the American National Election Study, 1972
	eli3	Scientists are in cahoots with politics and business.	adapted from Fawzi, 2019
	eli4	Scientists are often dishonest about their research findings.	verbatim from Morgan, Collins, Sparks, & Welch, 2018
Demands for decision-making sovereignty	dec1	The people should have influence on the work of scientists.	adapted from Schulz et al., 2018
	dec2	People like me should be involved in decisions about the topics scientists research.	verbatim from Schäfer, Füchslin, Metag, Kristiansen, & Rauchfleisch, 2018
	dec3	Scientists should listen more to what ordinary people think.	adapted from Schäfer et al., 2018
	dec4[a]	Scientists should do what they think is best and not follow the will of the people.	adapted from Brossard & Nisbet, 2007; European Values Study, 2008 (see also Bertsou & Pastorella, 2017; Hawkins, Riding, & Mudde, 2012)
Demands for truth-speaking sovereignty	tru1	In case of doubt, one should rather trust the life experience of ordinary people than the estimations of scientists.	adapted from Oliver & Rahn, 2016
	tru2	We should rely more on common sense and less on scientific studies.	adapted from Evans & Durant, 1995
	tru3	The opinions of ordinary people should be worth more than the estimations of scientists and experts.	adapted from Elchardus & Spruyt, 2016
	tru4	For the most important problems in life you need clear answers, not scientific theories.	adapted from Eigenberger & Sealander, 2001

Note. Items were measured with 5-point Likert scales ranging from 1 ("fully disagree") to 5 ("fully agree").

[a] Item reversed for analyses.

Supplementary Table SA2

Initial 17-item set (original German items)

Dimension	Label	Item	Reference
Conceptions of the ordinary people	ppl1	Über wichtige Fragen denken die einfachen Leute ähnlich.	adapted from Schulz et al., 2018
	ppl2	Die einfachen Leute teilen gemeinsame Werte und Interessen.	verbatim from Schulz et al., 2018
	ppl3	Was die einfachen Leute verbindet, ist, dass sie im Alltag ihrem gesunden Menschenverstand trauen.	new
	ppl4	Einfache Leute verbindet ein guter und ehrlicher Charakter.	verbatim from Schulz et al., 2018
	ppl5	Die Unterschiede zwischen einfachen Leuten und Wissenschaftlern sind viel grösser als die Unterschiede zwischen einfachen Leuten.	adapted from Akkerman et al., 2014
Conceptions of the academic elite	eli1	Wissenschaftler wissen nicht, was gut für die Gesellschaft ist.	adapted from Brossard & Nisbet, 2007
	eli2	Wissenschaftler sind nur auf ihren eigenen Vorteil aus.	adapted from the American National Election Study, 1972
	eli3	Wissenschaftler stecken mit Politik und Wirtschaft unter einer Decke.	adapted from Fawzi, 2019
	eli4	Wenn es um ihre Forschungsergebnisse geht, sind Wissenschaftler oft nicht ehrlich.	verbatim from Morgan et al., 2018
Demands for decision-making sovereignty	dec1	Das Volk sollte Einfluss auf die Arbeit von Wissenschaftlern haben.	adapted from Schulz et al., 2018
	dec2	Leute wie ich sollten mitentscheiden, zu welchen Themen Wissenschaftler forschen.	verbatim from Schäfer et al., 2018
	dec3	Wissenschaftler sollten mehr darauf hören, was einfache Leute denken.	adapted from Schäfer et al., 2018
	dec4[a]	Wissenschaftler sollten tun, was sie für das Beste halten, und nicht dem Willen des Volkes folgen.	adapted from Brossard & Nisbet, 2007; European Values Study, 2008 (see also Bertsou & Pastorella, 2017; Hawkins et al., 2012)
Demands for truth-speaking sovereignty	tru1	Im Zweifel sollte man eher der Lebenserfahrung einfacher Menschen vertrauen als Einschätzungen von Wissenschaftlern.	adapted from Oliver & Rahn, 2016
	tru2	Wir sollten uns mehr auf den gesunden Menschenverstand und weniger auf wissenschaftliche Studien verlassen.	adapted from Evans & Durant, 1995
	tru3	Die Meinung der einfachen Leute sollte mehr wert sein als die Einschätzung von Wissenschaftlern und Experten.	adapted from Elchardus & Spruyt, 2016
	tru4	Für die wichtigsten Probleme im Leben braucht man klare Antworten, keine wissenschaftlichen Theorien.	adapted from Eigenberger & Sealander, 2001

Note. Items were measured with 5-point Likert scales ranging from 1 (“lehne voll ab”) to 5 (“stimme voll und ganz zu”).

[a] Item reversed for analyses.

Supplementary Table SA3

Exploratory factor analysis with 17 items

	Factor 1	Factor 2	Factor 3	Factor 4
Initial eigenvalue	7.51	1.50	1.25	0.84
% of total variance explained after rotation	16.43	15.19	9.08	13.92

Label	Item	*M (SD)*	$\lambda_{\text{Factor 1}}$	$\lambda_{\text{Factor 2}}$	$\lambda_{\text{Factor 3}}$	$\lambda_{\text{Factor 4}}$	h^2
ppl1	The ordinary people think alike about important questions.	2.90 (1.08)		0.63			0.40
ppl2	Ordinary people share the same values and interests.	3.00 (1.10)		0.81			0.62
ppl3	What unites the ordinary people is that they trust their common sense in everyday life.	3.29 (1.13)		0.71			0.59
ppl4	Ordinary people are of good and honest character.	2.87 (1.13)		0.74			0.59
ppl5	The differences between ordinary people and scientists are much greater than the differences between ordinary people.	3.24 (1.18)	0.39	0.46			0.37
eli1	Scientists don't know what's good for society.	2.49 (1.02)	0.64				0.53
eli2	Scientists are only after their own advantage.	2.47 (1.09)	0.82				0.70
eli3	Scientists are in cahoots with politics and business.	2.93 (1.21)	0.65				0.59
eli4	Scientists are often dishonest about their research findings.	2.94 (1.08)	0.74				0.58
dec1	The people should have influence on the work of scientists.	2.73 (1.15)			0.83		0.69
dec2	People like me should be involved in decisions about the topics scientists research.	2.83 (1.15)			0.73		0.48
dec3	Scientists should listen more to what ordinary people think.	3.23 (1.12)	0.20		0.22	0.32	0.48
dec4[a]	Scientists should do what they think is best and not follow the will of the people.	2.80 (1.18)			0.43		0.20
tru1	In case of doubt, one should rather trust the life experience of ordinary people than the estimations of scientists.	2.87 (1.08)				0.65	0.66
tru2	We should rely more on common sense and less on scientific studies.	3.25 (1.15)				0.72	0.65
tru3	The opinions of ordinary people should be worth more than the estimations of scientists and experts.	2.58 (1.11)				0.50	0.62
tru4	For the most important problems in life you need clear answers, not scientific theories.	3.16 (1.20)				0.63	0.53

Note. $n = 853$. Analysis based on study 1 survey data. Items measured using 5-point Likert scales with higher values indicating stronger agreement. Four factors extracted as suggested by Horn's (1965) parallel analysis and Glorfeld's (1995) conservative parallel analysis (5000 iterations using the 95-percentile estimate). Extraction method: principal axis factoring. Rotation method: Promax. Loadings $\lambda < |0.20|$ not displayed. R package used: psych v1.9.12.31 (Revelle, 2020).

[a] Original item reversed.

Supplementary Table SA4

Exploratory factor analysis with the 8 SciPop Scale items: Factor correlations

	Conceptions of the ordinary people	Conceptions of the academic elite	Demands for decision-making sovereignty	Demands for truth-speaking sovereignty
Conceptions of the ordinary people	1			
Conceptions of the academic elite	0.59	1		
Demands for decision-making sovereignty	0.47	0.56	1	
Demands for truth-speaking sovereignty	0.69	0.77	0.53	1

Note. $n = 853$. Analysis based on study 1 survey data. Four factors extracted as suggested by Horn's (1965) parallel analysis and Glorfeld's (1995) conservative parallel analysis (5000 iterations using the 95-percentile estimate). Extraction method: principal axis factoring. Rotation method: Promax. R package used: psych v1.9.12.31 (Revelle, 2020).

Supplementary Table SA5

Confirmatory factor analyses with the 8 SciPop Scale items: Model fit information

	Single-group CFA	Multi-group CFA
χ^2	22.877	37.340
df	14	28
p	0.062	0.112
Robust CFI	0.994	0.990
Robust TLI	0.988	0.969
Robust RMSEA	0.027	0.044
SRMR	0.017	0.027

Note. $n = 986$ ($n_{French} = 235$, $n_{German} = 601$, $n_{Italian} = 150$). Analyses based on study 2 survey data. Grouping variable in multi-group CFA: Questionnaire language (French, German, Italian). Model identification and scale setting by means of the LSC method (Little et al., 2006). For the multi-group CFA, the error variance of sovpower1 was fixed to zero in the German and the Italian-speaking group. Estimation method: Maximum likelihood estimation with robust standard errors and a Satorra-Bentler scaled test statistic (to compensate for multivariate non-normality; Mardia's skewness: $z_{1,8} = 231.632$, $p < .001$, Mardia's kurtosis: $z_{2,8} = 12.640$, $p < .001$). R package used: lavaan v0.6-5 (Rosseel, 2019).

Supplementary Table SA6

Confirmatory factor analysis with the 8 SciPop Scale items: Loadings

		Conceptions of the ordinary people		Conceptions of the academic elite		Demands for decision-making sovereignty		Demands for truth-speaking sovereignty	
Item	*M (SD)*	Standardized Loading	*SE*	Standardized Loading	*SE*	Standardized Loading	*SE*	Standardized Loading	*SE*
ppl3	3.44 (1.06)	0.688***	0.047						
ppl4	3.06 (1.09)	0.692***	0.047						
eli2	2.56 (1.04)			0.677***	0.048				
eli3	2.93 (1.08)			0.646***	0.048				
dec1	2.75 (1.12)					0.952***	0.068		
dec2	2.81 (1.16)					0.454***	0.068		
tru1	3.02 (1.08)							0.728***	0.028
tru2	3.12 (1.11)							0.753***	0.028

Note. ***$p < .001$. $n = 986$. Analysis based on study 2 survey data. Model identification and scale setting by means of the LSC method (Little et al., 2006). Estimation method: Maximum likelihood estimation with robust standard errors and a Satorra-Bentler scaled test statistic (to compensate for multivariate non-normality; Mardia's skewness: $z_{1,8} = 231.632$, $p < .001$, Mardia's kurtosis: $z_{2,8} = 12.640$, $p < .001$). R package used: lavaan v0.6-5 (Rosseel, 2019).

Supplementary Table SA7

Confirmatory factor analysis with the 8 SciPop Scale items: Factor correlations

	Conceptions of the ordinary people	Conceptions of the academic elite	Demands for decision-making sovereignty	Demands for truth-speaking sovereignty
Conceptions of the ordinary people	1			
Conceptions of the academic elite	0.60***	1		
Demands for decision-making sovereignty	0.45***	0.55***	1	
Demands for truth-speaking sovereignty	0.76***	0.85***	0.55***	1

Note. ***$p < .001$. $n = 986$. Analysis based on study 2 survey data. Model identification and scale setting by means of the LSC method (Little et al., 2006). Estimation method: Maximum likelihood estimation with robust standard errors and a Satorra-Bentler scaled test statistic (to compensate for multivariate non-normality; Mardia's skewness: $z_{1,8} = 231.632$, $p < .001$, Mardia's kurtosis: $z_{2,8} = 12.640$, $p < .001$). R package used: lavaan v0.6-5 (Rosseel, 2019).

Supplementary Table SA8

Multi-group confirmatory factor analysis with the 8 SciPop Scale items: Loadings

Item	Conceptions of the ordinary people		Conceptions of the academic elite		Demands for decision-making sovereignty		Demands for truth-speaking sovereignty	
	Standardized Loading	*SE*	Standardized Loading	*SE*	Standardized Loading	*SE*	Standardized Loading	*SE*
French SciPop Scale								
ppl3	0.643***	0.110						
ppl4	0.766***	0.110						
eli2			0.731***	0.072				
eli3			0.710***	0.072				
dec1					0.840***	0.089		
dec2					0.549***	0.089		
tru1							0.669***	0.060
tru2							0.730***	0.060
German SciPop Scale								
ppl3	0.689***	0.060						
ppl4	0.694***	0.061						
eli2			0.626***	0.078				
eli3			0.615***	0.078				
dec1					1.000***	0.021		
dec2					0.428***	0.043		
tru1							0.753***	0.045
tru2							0.786***	0.041
Italian SciPop Scale								
ppl3	0.750***	0.113						
ppl4	0.594***	0.133						
eli2			0.799***	0.083				
eli3			0.601***	0.096				
dec1					1.000***	0.039		
dec2					0.419***	0.099		
tru1							0.682***	0.091
tru2							0.727***	0.080

Note. ***$p < .001$. $n = 986$ ($n_{French} = 235$, $n_{German} = 601$, $n_{Italian} = 150$). Analysis based on study 2 survey data. Grouping variable: Questionnaire language (French, German, Italian). Model identification and scale setting by means of the LSC method (Little et al., 2006). Error variance of sovpower1 fixed to zero in German and Italian-speaking groups. Estimation method: Maximum likelihood estimation with robust standard errors and a Satorra-Bentler scaled test statistic (to compensate for multivariate non-normality; Mardia's skewness: $z_{1,8} = 231.632$, $p < .001$, Mardia's kurtosis: $z_{2,8} = 12.640$, $p < .001$). R package used: lavaan v0.6-5 (Rosseel, 2019).

Supplementary Table SA9

Correlations of SciPop Score, subscale scores, and related constructs/items

	Science-related populist attitudes (SciPop Scale Score[a])	Conceptions of the ordinary people (Ordinary People Subscale Score[b])	Conceptions of the academic elite (Academic Elite Subscale Score[b])	Demands for decision-making sovereignty (Decision-Making Subscale Score[b])	Demands for truth-speaking sovereignty (Truth-Speaking Subscale Score[b])
Trust in science[c]	-0.20***		-0.29***	-0.11***	-0.31***
Trust in university scientists[c]	-0.26***	-0.11***	-0.35***	-0.10**	-0.37***
Trustworthiness scientists (METI)[d]	-0.18***		-0.24***	-0.09**	-0.22***
"Science and research make our lives better"[e]	-0.23***	-0.06*	-0.24***	-0.09**	-0.31***
"Science makes our ways of life change too fast"[e]	0.25***	0.17***	0.21***	0.23***	0.25***
"We rely too heavily on science"[e]	0.26***	0.14***	0.26***	0.19***	0.32***
"Media coverage on science and research is trustworthy"[f]	-0.17***		-0.21***	-0.08*	-0.16***

Note. ***$p < .001$. **$p < .01$. *$p < .05$. Pearson coefficients displayed. Non-significant correlations not displayed.

[a] The SciPop Score was obtained following the "Goertz approach" (Wuttke, Schimpf, & Schoen, 2020). In a first step, unweighted mean values were computed for each of the four 2-item subscales. In a second step, the smallest of these four values was used as the SciPop Score. Higher values indicate stronger science-related populist attitudes.

[b] The four subscale scores are unweighted mean values of the 2-item subscales. Higher values indicate more favorable conceptions of the ordinary people (Ordinary People Subscale Score), more unfavorable conceptions of the academic elite (Academic Elite Subscale Score), stronger demands for decision-making sovereignty (Decision-Making Subscale Score), and stronger demands for truth-speaking sovereignty (Truth-Speaking Subscale Score).

[c] Measured using a 5-point Likert scale with higher values indicating higher trust.

[d] Measured with a shortened version of the Muenster Epistemic Trustworthiness Inventory (METI; Hendriks, Kienhues, & Bromme, 2015). Items were measured using 5-point semantic differentials with higher values indicating greater perceived trustworthiness. Note that in its original form, the METI contains 14 items indicating trustworthiness on three dimensions, i.e., expertise, integrity, and benevolence. Analyzing the original data from Hendriks et al. (2015) with CFA, we identified the three best-performing items for each dimension and constructed a shortened 9-item METI.

[e] Measured with items adapted from Prpić (2011) using 5-point Likert scales with higher values indicating stronger agreement.

[f] Measured using a 5-point Likert scale with higher values indicating stronger agreement.

Supplementary Table SA10

Items of the final SciPop Scale (English translations for the article)

Dimension	Label	Item	Reference
Conceptions of the ordinary people	ppl3	What unites the ordinary people is that they trust their common sense in everyday life.	new
	ppl4	Ordinary people are of good and honest character.	verbatim from Schulz et al., 2018
Conceptions of the academic elite	eli2	Scientists are only after their own advantage.	adapted from the American National Election Study, 1972
	eli3	Scientists are in cahoots with politics and business.	adapted from Fawzi, 2019
Demands for decision-making sovereignty	dec1	The people should have influence on the work of scientists.	adapted from Schäfer et al., 2018
	dec2	People like me should be involved in decisions about the topics scientists research.	verbatim from Schäfer et al., 2018
Demands for truth-speaking sovereignty	tru1	In case of doubt, one should rather trust the life experience of ordinary people than the estimations of scientists.	adapted from Oliver & Rahn, 2016
	tru2	We should rely more on common sense and less on scientific studies.	adapted from Evans & Durant, 1995

Note. Items were measured with 5-point Likert scales ranging from 1 (“fully disagree”) to 5 (“fully agree”).

Supplementary Table SA11

Items of the final SciPop Scale (German version)

Dimension	Label	Item	Reference
Conceptions of the ordinary people	ppl3	Was die einfachen Leute verbindet, ist, dass sie im Alltag ihrem gesunden Menschenverstand trauen.	new
	ppl4	Einfache Leute verbindet ein guter und ehrlicher Charakter.	verbatim from Schulz et al., 2018
Conceptions of the academic elite	eli2	Wissenschaftler sind nur auf ihren eigenen Vorteil aus.	adapted from the American National Election Study, 1972
	eli3	Wissenschaftler stecken mit Politik und Wirtschaft unter einer Decke.	adapted from Fawzi, 2019
Demands for decision-making sovereignty	dec1	Das Volk sollte Einfluss auf die Arbeit von Wissenschaftlern haben.	adapted from Schäfer et al., 2018
	dec2	Leute wie ich sollten mitentscheiden, zu welchen Themen Wissenschaftler forschen.	verbatim from Schäfer et al., 2018
Demands for truth-speaking sovereignty	tru1	Im Zweifel sollte man eher der Lebenserfahrung einfacher Menschen vertrauen als Einschätzungen von Wissenschaftlern.	adapted from Oliver & Rahn, 2016
	tru2	Wir sollten uns mehr auf den gesunden Menschenverstand und weniger auf wissenschaftliche Studien verlassen.	adapted from Evans & Durant, 1995

Note. Items were measured with 5-point Likert scales ranging from 1 (“stimme überhaupt nicht zu”) to 5 (“stimme voll und ganz zu”).

Supplementary Table SA12

Items of the final SciPop Scale (French version)

Dimension	Label	Item	Reference
Conceptions of the ordinary people	ppl3	Ce qui unit les gens simples, c'est qu'ils font confiance à leur bon sens dans la vie quotidienne.	new
	ppl4	Les gens simples ont en commun un caractère bon et honnête.	verbatim from Schulz et al., 2018
Conceptions of the academic elite	eli2	Les scientifiques ne voient que leur propre avantage.	adapted from the American National Election Study, 1972
	eli3	Les scientifiques sont de mèche avec la politique et l'économie.	adapted from Fawzi, 2019
Demands for decision-making sovereignty	dec1	Le peuple devrait avoir une influence sur le travail des scientifiques.	adapted from Schäfer et al., 2018
	dec2	Les personnes comme moi devraient prendre part à la décision sur quels thèmes les scientifiques doivent faire des recherches.	verbatim from Schäfer et al., 2018
Demands for truth-speaking sovereignty	tru1	En cas de doute, on devrait plutôt faire confiance à l'expérience des gens simples qu'aux estimations des scientifiques.	adapted from Oliver & Rahn, 2016
	tru2	Nous devrions nous baser davantage sur le bon sens commun et moins sur les études scientifiques.	adapted from Evans & Durant, 1995

Note. Items were measured with 5-point Likert scales ranging from 1 ("n'approuve pas du tout") to 5 ("approuve totalement").

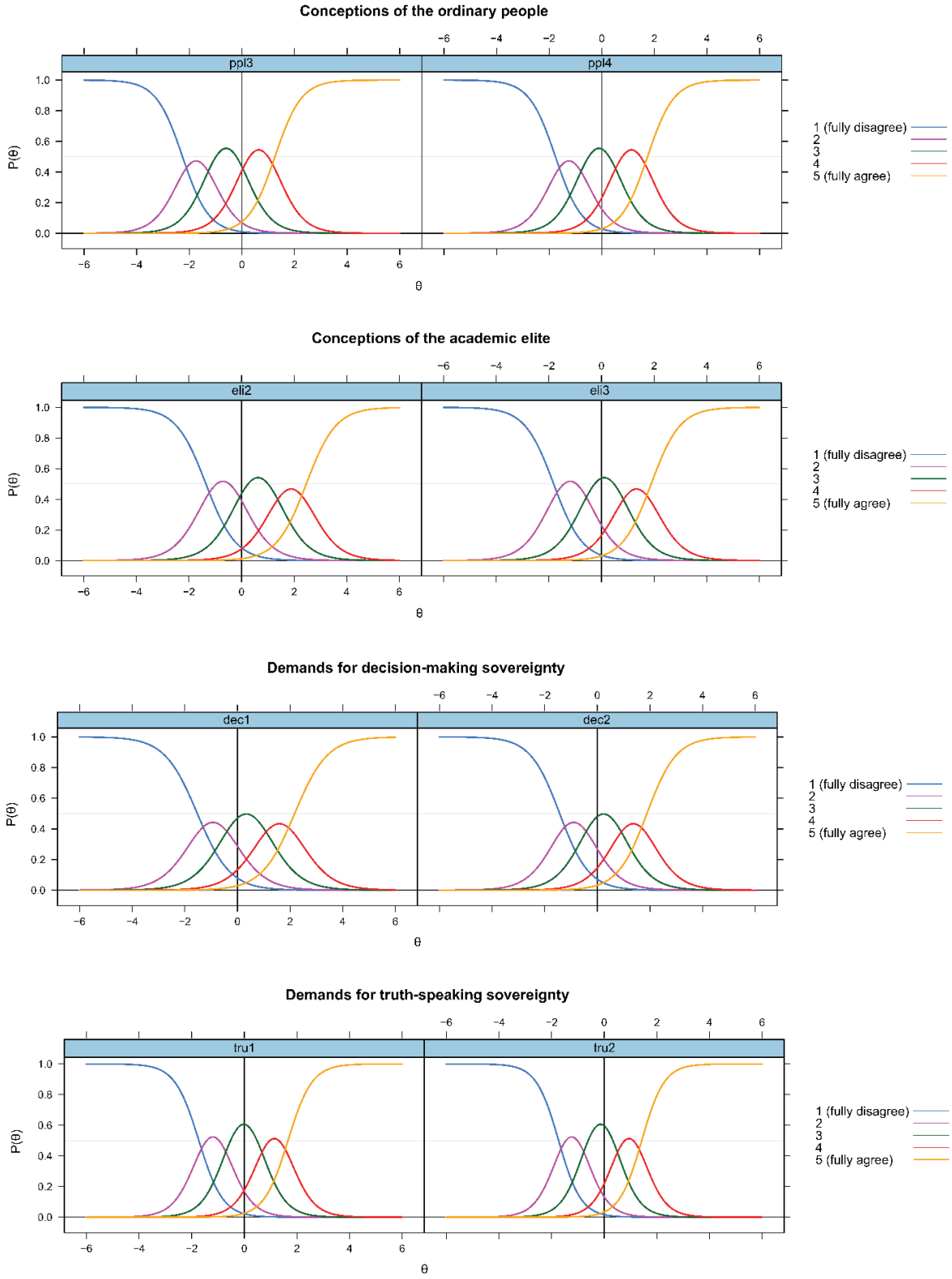
Supplementary Table SA13

Items of the final SciPop Scale (Italian version)

Dimension	Label	Item	Reference
Conceptions of the ordinary people	ppl3	Ciò che unisce la gente comune è la fiducia nel buon senso nella vita quotidiana.	new
	ppl4	La gente comune è generalmente buona e onesta.	verbatim from Schulz et al., 2018
Conceptions of the academic elite	eli2	Gli scienziati sono orientati solo al loro tornaconto personale.	adapted from the American National Election Study, 1972
	eli3	Gli scienziati fanno affari sottobanco con il mondo politico ed economico.	adapted from Fawzi, 2019
Demands for decision-making sovereignty	dec1	Il popolo dovrebbe poter influire sul lavoro degli scienziati.	adapted from Schäfer et al., 2018
	dec2	La gente come me dovrebbe partecipare alle decisioni sui temi oggetto di ricerca scientifica.	verbatim from Schäfer et al., 2018
Demands for truth-speaking sovereignty	tru1	In caso di dubbio, ci si dovrebbe fidare dell'esperienza di vita della gente comune piuttosto che delle stime degli scienziati.	adapted from Oliver & Rahn, 2016
	tru2	Dovremmo affidarci di più al buon senso e meno agli studi scientifici.	adapted from Evans & Durant, 1995

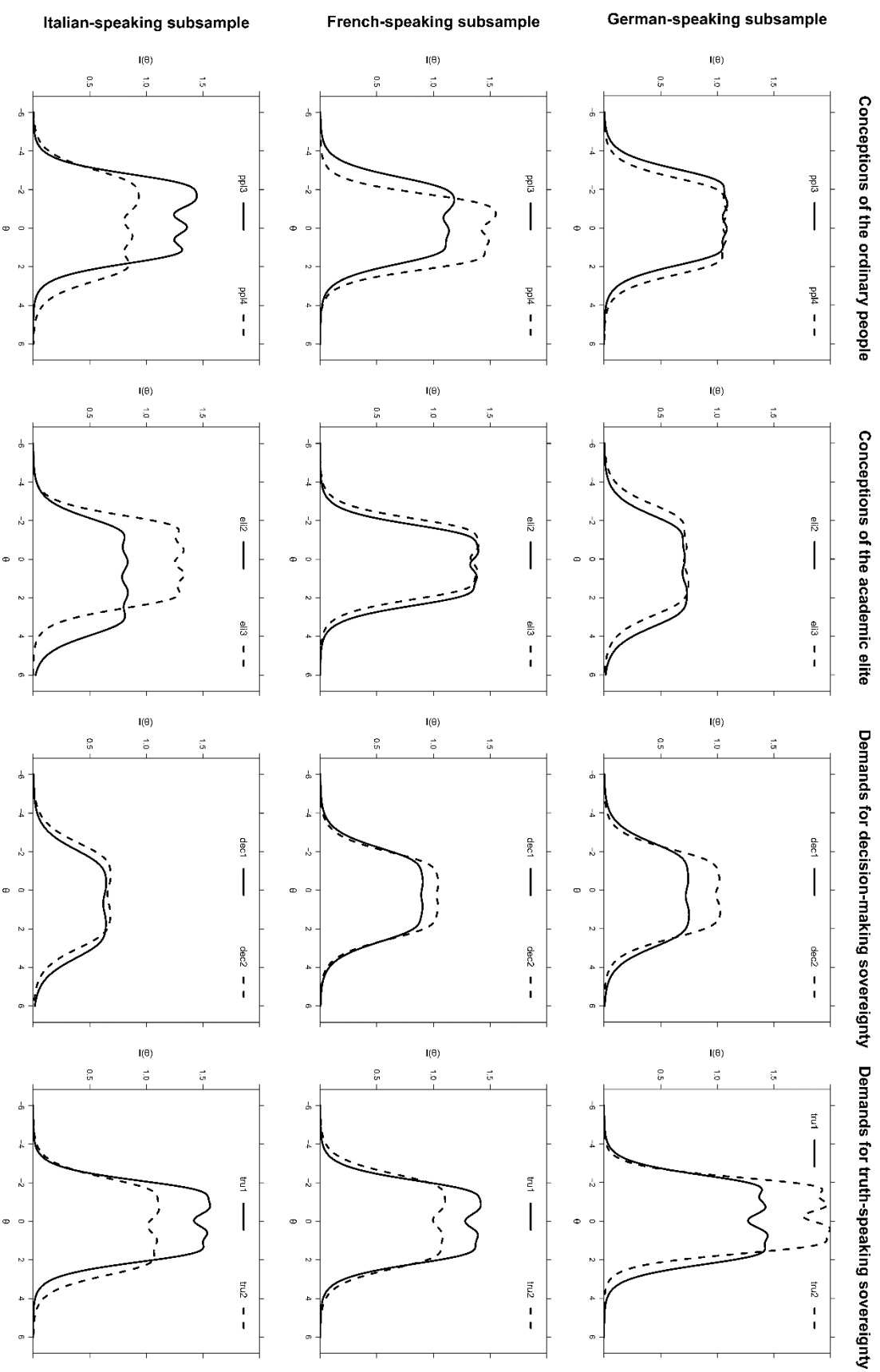
Note. Items were measured with 5-point Likert scales ranging from 1 ("non sono assolutamente d'accordo") to 5 ("sono assolutamente d'accordo").

Supplementary Figures



Supplementary Figure SA1. *Category Characteristic Curves of the 8 SciPop Scale items*

Note. Category Characteristic Curves visualize the probability $P(\theta)$ that individuals choose an item response category that corresponds with their latent trait level θ. Analyses relied on Graded Rating Scales Models (Muraki, 1992) and were conducted with the R package mirt v1.31 (Chalmers, 2019).



Supplementary Figure SA2. *Item Information Curves for German, French, and Italian-language subsamples*

Note. Analyses relied on Graded Rating Scales Models (Muraki, 1992) and were conducted with the R package mirt v.1.31 (Chalmers, 2019).

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