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A New Instrument to Measure Cultural Knowledge

Abstract

Cultural knowledge is central to social participation and is particularly relevant for educational research. Based on Bourdieu's concept of capital, 14 items are presented to measure highbrow cultural knowledge in the German general population. These have been tested on a cross-sectional survey with more than 7000 participants. This instrument focuses on highbrow cultural knowledge in literature, classical music, theatre, and visual arts. The evaluations carried out descriptively and utilizing item response theory have shown that the instrument is high quality and can measure cultural capital. In addition to high reliability ($\alpha > .80$), the values of the generated knowledge score were also approximately normally distributed. Subsequent validity analyses demonstrated that the instrument correlates as expected with other measures, such as educational attainment and social prestige. The existence of slight ceiling effects is not problematic for a representative random sample but should be considered if special and highly educated subpopulations are to be studied.

Keywords

cultural knowledge, IRT, cultural capital, highbrow culture

Ein neues Instrument zur Erfassung kulturellen Wissens

Zusammenfassung

Kulturelles Wissen spielt für die gesellschaftliche Teilhabe eine zentrale Rolle und ist besonders für die Bildungsforschung relevant. Aufbauend auf Bourdieus Ka-

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pitalkonzept werden 14 Items vorgestellt, um hochkulturelles Wissen in der deutschen Allgemeinbevölkerung zu messen. Diese wurden an einer Querschnittsbefragung mit mehr als 7000 Teilnehmer:innen getestet. Dieses Instrument zielt auf hochkulturelles Wissen in den Bereichen Literatur, klassische Musik, Theater und bildende Kunst ab. Die Auswertungen, die deskriptiv und mittels Item-Response-Theorie erfolgten, haben aufgezeigt, dass das Instrument eine hohe Qualität aufweist und in der Lage ist, kulturelles Kapital zu messen. Neben hohen Reliablilitätswerten (α > .80) zeigten auch die Werte des generierten Wissensscores eine approximative Normalverteilung. Nachfolgende Validitätsanalysen belegten, dass das Instrument erwartungsgemäß mit anderen Maßen wie den erreichten Bildungsabschlüssen und dem sozialen Prestige korreliert. Die Existenz von leichten Deckeneffekten ist für eine repräsentative Zufallsstichprobe unproblematisch, sollte jedoch berücksichtigt werden, wenn spezielle und vor allem hochgebildete Subpopulationen untersucht werden sollen.

Schlagworte
kulturelles Wissen, IRT, Kulturkapital, Hochkultur

1. Introduction

While there are many instruments available to measure general cognitive ability or intelligence, there are much fewer instruments at hand that target cultural knowledge. Even if this part of general knowledge is usually less prominent, it deserves attention for various reasons. Exemplary, it is well known that highbrow cultural knowledge is a mechanism that explains how social inequality is transmitted through generations and contributes to the persistence or even emergence of social inequality (Bourdieu, 1984; DiMaggio, 1982; Lareau, 2015). A comprehensive instrument to measure highbrow cultural knowledge is therefore a desideratum for current survey methodology. To fill this gap, we present a 14-item scale which has been tested and validated in a large-scale assessment (the German National Educational Panel Study – NEPS) with more than 7000 participants.

Since the concept of culture itself is complex (Kröner et al., 2021, pp. 12–13; Antweiler, 2018), we emphasize right at the beginning that in this paper, we are testing the validity of an instrument that is limited to highbrow cultural knowledge in the areas of literature, classical music, theatre, and visual arts in a western country – which does not mean that other forms of cultural knowledge are not valuable or relevant. We anticipate this instrument to work as intended and to help answering various research questions, such as (a) describing the distribution of certain forms of cultural knowledge in the population and across sociodemographic indicators such as level of education, occupational status or social class, (b) illustrating the impact of cultural knowledge on educational outcomes at various stages of life (c) explaining the intergenerational transmission of cultural knowledge, and (d)

quantifying the returns to cultural knowledge across the life course. In the following study, we describe the instrument in detail and analyze its properties using item response theory (IRT). Specifically, the following research questions are addressed: First, what is the overall statistical reliability and difficulty of the instrument? Second, what is the distribution of cultural knowledge in the NEPS sample? Third, how are highbrow cultural knowledge and various sociodemographic constructs related?

Since a large sample is available, we are able to study the new instrument in a precise fashion and vouch for its overall reliability, validity and quality.

2. Theoretical Foundations

2.1 Bourdieu and Various Forms of Capital

According to Pierre Bourdieu (1983), social differences in educational success can be explained primarily by differences in family endowment with educationally relevant economic, cultural and social capital. Depending on the social origin and the availability of the different forms of capital, children are socialized differently and experience different practices, which ultimately leads to a different *habitus* (Bourdieu, 1984*)*. The habitus can be described as the way people perceive, think and act – all previous experiences of the person are part of it (Bourdieu, 1976). Thus, differences in living conditions that vary by social status generate different forms of habitus. In concrete, the habitus includes the preference to surround one's self with objects such as certain books, cars or even clothing, as well as the use of (distinctive) practices – for example, the participation in certain sports and leisure activities, but also the use of a specific language (Bourdieu, 1984, pp. 169–175).

While social and especially economic capital can be measured and defined relatively clearly (see e. g., Baoyan & Minggang, 2015; Kim & Schneider, 2005; Ream & Palardy, 2008), there are greater challenges when it comes to cultural capital: On the one hand, Bourdieu's definition itself is rather diffuse (Davies & Rizk, 2018), and on the other hand, cultural capital often operates invisibly and unconsciously – as Bourdieu describes, cultural capital is the families' "best hidden and socially most effective educational investment" (Bourdieu, 1983, p. 186).

Generally, cultural capital in the sense of Bourdieu can be defined as the "familiarity with the culture of the 'dominant' class, understood as the elevated tastes, dispositions, and practices exercised by the upper classes and professionals" (Davies & Rizk, 2018, p. 337, see also DiMaggio, 1982; Lamont & Lareau, 1988; Purhonen et al., 2011; Sullivan, 2001). The main art genres of a certain dominant culture are literature, classical music, theatre, and visual arts (Bourdieu, 1977; Purhonen et al., 2011; Sullivan, 2001). Since school education is strongly oriented towards "elite culture" and thus promotes that social advantages become educational advantages, social inequalities can be explained almost completely by this type of capital (Bourdieu & Passeron, 2007, p. 37). In this context, it is not so much the objectified cultural capital (e.g., books or works of art) that is relevant, but rather the incor-

porated cultural capital such as special knowledge or certain manners as "permanent dispositions of the organism" (Bourdieu, 1983, p. 185). The relevance of cultural capital for educational success in general has already been highlighted several times by empirical studies (for Germany, see e. g., Hinz & Groß, 2006; Jungbauer-Gans, 2006; Zinnecker & Stecher, 2006). Based on the theoretical considerations regarding the concepts habitus and cultural capital – and taking the empirical results so far into account – we can assume that with higher education and higher social status, the endowment with cultural capital will also be larger. Interestingly, this phenomenon is empirically not only visible in the comparison of low and highly educated individuals, even students at universities of applied sciences and general universities studying the same subject differ in their knowledge and habitus (Baltes, 2010).

Although cultural capital in its entirety is relevant for educational pathways and thus for the positioning in the social field, it is often narrowed down in its operationalization: cultural practices and possessions (e.g., how long one reads or how many works of art one owns) are quantified, especially in large-scale studies (OECD, 2019; TIMSS, 2019). A qualitative approach, for example through the operationalization of cultural capital via the question if someone knows certain books or artists, was rarely used (e.g., Bennet et al., 2005; Purhonen et al., 2011; Prussog-Wagner & Sandbrink, 2020; Zimdars et al., 2009). However, attaching particular importance to Bourdieu's comprehensive approach, especially cultural knowledge as a dimension of cultural capital, seems essential when it comes to explaining social inequalities. Some studies have supported these theoretical considerations on the positive impact of cultural knowledge on educational success: For example, preschool children with higher cultural knowledge are less likely to be enrolled late in school (Tuppat & Becker, 2014) and the probability of admission to elite universities is higher for school graduates with high cultural capital, despite the same grades and certificates (Zimdars et al., 2009).[1]

The underlying mechanisms that lead to cultural knowledge having a positive impact on educational success are a) self-selection, because students with higher cultural knowledge learn to deal confidently with educational institutions, feel more at home in them, and therefore are less likely to leave them (Dumais, 2002; Lareau, 2015) b) the signaling effect of cultural capital on teachers or other members of the educational institutions, who (unconsciously) assess students' performance differently (DiMaggio, 1982; Dumais, 2002; Leopold & Shavit, 2013), and c) the content advantage, because students with high amounts of cultural knowledge already have a lot of knowledge in some subjects that they can apply in class and exams (Bourdieu & Passeron, 2007; Lamont & Lareau, 1988). These explanations suggest that it is important to focus also on the quality and the nature of the knowledge instead of just the quantity.

1 Bourdieu also classifies other types of knowledge as cultural knowledge, e. g., knowledge about the university system (Bourdieu & Passeron, 2007; see also Lareau, 2015). However, since this represents an entirely different dimension of cultural knowledge, the following paper will focus on the subfield highbrow cultural knowledge.

2.2 Further relevance of cultural knowledge and existing instruments

Besides the obvious applications to habitus, social classes, or the reproduction of various forms of capital, cultural knowledge has seen various other relevant applications. Studies show the importance of measuring cultural knowledge and the potential uses of appropriate instruments: Sullivan (2001) for example shows for England that the effects of cultural activities on school performance is mediated by cultural knowledge; Veenstra (2005) demonstrates for Canada how highbrow cultural knowledge functions as a marker of distinction and therefore as a marker of certain social classes and Sauermann and Hämmerling (2015) indicate that migration-specific inequalities in elementary school, in part, can be explained by foreign mothers' lack of cultural knowledge. In addition, more general research interests such as the characterization of cultural behavior and cultural competencies in Germany have already been addressed using similar instruments (Otte et al., 2022). Summarized, this demonstrates that cultural knowledge is a relevant construct for various research questions, which is also the reason why there are already some instruments available.

We want to highlight how the new instrument differs from the ones already presented in the literature and how it can improve them. In contrast to studies that ask whether the interviewee knows something or not in a binary fashion (see Bennett et al., 2005; Purhonen et al., 2011; Veenstra, 2005), this paper presents a construct that measures actual knowledge through several items which form a (continuous) score. In concrete terms, this means that each item forms a quiz-question with exactly one correct answer and three false answers. This approach reduces biases such as social desirability and self-overestimation but may at first appear to increase the potential dropout rate due to frustration. The further literature review reveals that many studies do not ask about actual knowledge in form of a quiz (right/wrong questions) but focus on aspects like cultural interests, cultural participation or grades in various school subjects (DiMaggio, 1982; Kalter et al., 2013; Sullivan 2001, 2003), which is clearly not identical to factual knowledge. Another study contains such questions but also continues with actual knowledge about famous persons (Zimdars et al., 2009). The respondents were asked to assign these persons to fields (for example, know that Albert Einstein was a scientist and not an artist). The 20 persons in the instrument were, however, taken from various fields (science, arts, politics, history) and the resulting scale hence not only measures highbrow *cultural* knowledge. Finally, an instrument from Germany relies on multi-media as the respondents were shown various paintings and played actual music (Prussog-Wagner & Sandbrink, 2020). While this is highly interesting and a superior form to measure actual knowledge, it is difficult or impossible to apply to some studies and survey modes, especially on paper-and-pencil tests. Our instrument relies on text-form items only.

The presented instrument was developed in a theory-driven multistage procedure. The cultural products addressed by the questions were identified

through agents and institutions that are highly relevant in the cultural field. In the field of visual arts for example, public information from the leading museums in the capitals of the 16 German federal states were analyzed to create a list of all artists in this field who were on display in at least six of the 16 permanent exhibitions in 2012/13. All artists originated from the 14th to the 20th century. The entire theory-based item selection process is described systematically in Goßmann and Mätzke (2019) and will not be discussed further in this paper.

What makes the construct unique is that there is no other such systematically developed, relatively short instrument for the German context. The construct opens up the possibility of using cultural knowledge theoretically embedded in studies with a relatively broad focus without requiring a large amount of time.

For the following evaluation of the statistical soundness of the proposed instrument, we used IRT methodology and validated the resulting scale with various socio-demographic measurements. After presenting the results, a discussion of the scope and the limitation of the instrument follows.

3. Method

3.1 Data and Sample

All empirical analyses are based on the German National Educational Panel Study (NEPS) data, starting cohort 6 (adults).[2] The NEPS is a comprehensive longitudinal study to evaluate the role of education from a life-course perspective (Blossfeld & Roßbach, 2019). Eligible for the first sample, drawn in 2007, were all adults born between 1944 and 1986. Multiple refreshment samples were drawn in between (2009, 2011); the most recent wave of the survey is 14 (in 2024). The total sample comprises 7,052 individuals which were surveyed between September 2019 and March 2020, either personally (CAPI, more than 95 % of all respondents) or via telephone (CAPI). The surveys were conducted by *infas* (Bonn); the realization rate is 86.7 % (Malina et al., 2020). The sample concerning the cultural knowledge items comprises all respondents of the NEPS wave 12, except those who refused to participate in the quiz ($N = 10$). Furthermore, the quiz was terminated automatically for all respondents who answered the five first questions incorrectly or refused to answer. Since for these respondents only little information is available, they were also removed for the following analyses ($N = 16$), which leads to a total of 7,026 individuals in the sample. The most important information is that the male to female distribution is highly similar (0.49 to 0.51) and that the mean age is 57.4 years (me-

2 This paper uses data from the National Educational Panel Study (NEPS): Starting Cohort Adults, doi:10.5157/NEPS:SC6:12.1.0. From 2008 to 2013, NEPS data was collected as part of the Framework Program for the Promotion of Empirical Educational Research funded by the German Federal Ministry of Education and Research (BMBF). As of 2014, NEPS has been carried out by the Leibniz Institute for Educational Trajectories (LIfBi) in cooperation with a nationwide network.

dian 58 years). The age distribution is visualized in the appendix in Figure A1. It should be noted that due to the long-lasting nature of the panel study, which lacks recent refreshment samples, the current sample is no longer representative of the overall German population. Since it is not the aim of the current study to analyze the overall cultural knowledge in the German population, but rather to evaluate the new instrument and test whether it yields valid and reliable results, this isn't a disruptive factor. We present a summary of sociodemographic descriptive results in the appendix.

3.2 Instrument and Sociodemographic Variables

Every of the 14 items had up to four possible responses each, exactly one of which is factually correct. The alternative option given was to refuse an answer or to choose "I don't know". The complete list of all questions in German and the English translation is provided in the appendix (Table A1).

The order of the items was fixed in the questionnaire, starting with the easiest item and afterwards in increasing difficulty as indicated by the pretest. Interviewers were instructed to be absolutely neutral and never judge a response. Respondents were instructed to never guess an answer but choose "I don't know" if they did not know the answer or were very insecure about their response. If a respondent refused to answer two times in a row, the quiz was automatically ended. Afterwards, there was no information given about correct answers or how well the respondent did in the quiz.

The average time to answer all 14 items was 154 seconds ($SD = 33$), the median duration was 148 seconds. 90 % of all respondents took between 116 and 212 seconds.

Further below we want to demonstrate how cultural knowledge correlates with various sociodemographic variables as a test for validity. These variables are the following: First, the highest educational qualification. There are five categories: no qualification or lower secondary (*Hauptschulabschluss*), intermediate qualification (*Mittlere Reife*), higher education eligibility (*Abitur*), university of applied sciences degree, university degree. Second, the MPS (Magnitude Prestige scale) is based on the occupation a participant has in the labor market; higher values stand for a higher prestige (Christoph, 2005). Individuals who are retired have no information in this variable and the case number is lower. Third, the EGP classes, based on the occupations, are summarized into 3 groups (Service class = I/II; Middle class = IIIab/Working class = V VI VIIab/self-employed excluded). Fourth, we use the cultural capital indicator. This is a continuous and approximately normal distributed variable, which measured incorporated and objectified cultural capital. In this measurement, nine different variables are integrated (e.g., overall number of books in the household, possession of art in the household, how often per year a respondent takes part in highbrow activities [visiting a museum, a theatre, or the opera]; for

more information about the measurement of cultural capital in the NEPS, see Goßmann, 2018). The statistical reliability of this scale is .70 (Cronbach's Alpha).

3.3 Strategy of Analysis

For the analysis of the quiz items, multiple statistical techniques were used. First, all items were recoded into binary items with a value 1 if the correct answer was given or 0 if an incorrect answer or "don't know" was given. Items that were refused or were missing for other reasons were not evaluated. However, this share was extremely small (< 1%) and therefore no additional techniques were used to impute this information. Starting simple, an overview table and a sum score that was computed as the total number of correct items per respondent are presented. Afterwards, the reliability of the construct was tested. Continuing with advanced models, a 3-parameter model was computed within an IRT framework to assess differentiation, difficulty and the guessing parameter, which are all highly informative (Boeck & Wilson, 2004; Moosbrugger, 2012). After that, a latent score was generated via Empirical Bayes Means. This variable was utilized in the subsequent correlation analyses to test different criteria of validity. Taken together, the analyses should give a comprehensive overview of the quality of the construct and items.

4. Empirical Results

4.1 Descriptive Findings

The first table (Table 1) presented, for which the share of correct and incorrect answers per item was computed, gives an overview over the difficulty of each item by descriptive means. Additionally, the incorrect share is furthermore split up into wrong answers and "I don't know" answers.

As the numbers clearly indicate, the first items were easier to answer than the following ones. Especially the first item needs to be considered an ice-breaking question, since apparently more than 99 % of all respondents knew that Mozart was a composer. Other questions were by far more difficult, such as number 12, where only 28 % of all respondents were able to state correctly that *Carmen* was composed by Georges Bizet. These first impressions already indicate that the items apparently have a different difficulty to answer. Note that columns "correct" and "incorrect" always sum up to 100 % and "Wrong answer" and "Don't know" sum up to the share that is given in "incorrect". We continued by computing the sum score, which is simply the sum of all correct items per respondent. This shows how many items a respondent was able to answer, on average. The results are presented in Figure 1.

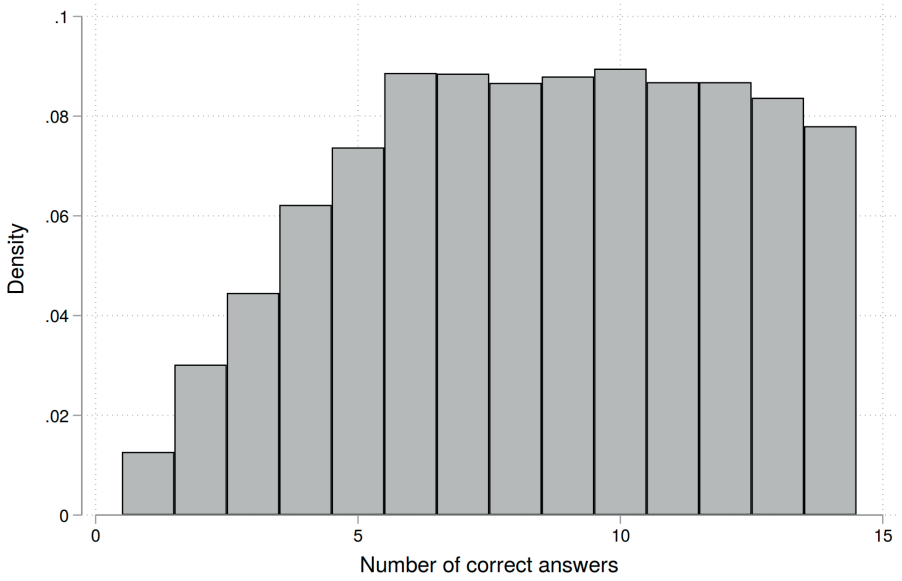
The number of correct answers ranges accordingly to the number of items from 1 to 14. Note that zero correct answers were not possible since these respondents finished the quiz early and therefore were not counted, as explained above. The dis-

Table 1: Item overview and IRT parameters

Item	Descriptive statistics (in %)				3 Parameter IRT Model	
	Correct	Incorrect	Of which: Wrong answer	Of which: Don't know	Discrimination	Difficulty
Mozart	99.56	0.44	0.43	0.01	0.521** (0.200)	-10.59** (3.875)
Hesse	91.05	8.95	2.57	6.38	1.743*** (0.0805)	-1.870*** (0.0550)
Rubens	86.85	13.15	1.3	11.85	2.414*** (0.102)	-1.348*** (0.0324)
Puccini	72.37	27.63	6.69	20.94	2.433*** (0.0886)	-0.695*** (0.0231)
Klee	58.7	41.3	13.84	27.46	2.875*** (0.112)	-0.223*** (0.0200)
Rossini	60.74	39.26	6.43	32.83	1.408*** (0.0487)	-0.373*** (0.0274)
Friedrich	55.44	44.56	19.18	25.38	2.482*** (0.0907)	-0.127*** (0.0207)
Buechner	70.05	29.95	3.19	26.76	1.366*** (0.0487)	-0.788*** (0.0321)
Weber	44.5	55.5	19.95	35.55	1.364*** (0.0482)	0.292*** (0.0274)
Brentano	35.95	64.05	8.35	55.7	2.329*** (0.100)	0.517*** (0.0222)
La Traviata	65.1	34.9	9.21	25.69	1.494*** (0.0506)	-0.542*** (0.0273)
Carmen	28.09	71.91	28.95	42.96	2.285*** (0.0940)	0.803*** (0.0248)
Guernica	31.63	68.37	5.36	63.01	1.451*** (0.0704)	0.848*** (0.0311)
The Scream	54.37	45.63	10.57	35.06	2.254*** (0.0797)	-0.0967*** (0.0212)
Guessing parameter					0.0331*** (0.00485)	

Note. NEPS SC6. Standard errors in parentheses. $N = 7026$. The order in the table corresponds to the order in the questionnaire. * $p < .05$, ** $p < .01$, *** $p < .001$

Figure 1: Sum score



Note. NEPS SC6, $N = 7026$.

tribution of this variable is of greatest interest as it is relatively skewed on the left side. This means that only few individuals had a very low score. However, the distribution differs from a normal distribution since the number of respondents with very high scores was rather high. The fact that there is no strong skew on the right side of the distribution but rather a plateau indicates that a ceiling is present, as a quite large share of the sample was able to answer all questions correctly (7.8 %). This means that in the current sample, the items were not fully able to differentiate precisely very high levels of cultural knowledge.

4.2 Reliability

As a next step, we computed the overall reliability of the construct, which can be measured using statistics like Cronbach's Alpha and McDonald's Omega (McDonald, 2013; Zumbo et al., 2007). Cronbach's Alpha is .836, McDonald's Omega is .829 ($N = 7026$). As the numbers underline, the reliability of the scale is rather fine as values above .80 are indicative of a high quality. It is also positive to note that Alpha and Omega are very similar, which is a sign of robustness, as the reliability is not depending on the type of statistic chosen.

4.3 IRT Modelling

After discussing some basic properties of the scale, to continue with advanced statistical models which are embedded in IRT seems appropriate. This framework allows a much more differentiated assessment of the overall construct of each item. The basic idea is that the probability to answer an item depends on its difficulty and the overall score should be higher for individuals who get more difficult questions correct. Since the different difficulty levels of the questions should be taken into account, it was not possible to simply count the number of correct responses, which hence would have been accompanied by the loss of this information. Therefore, we estimated a 3-parameter model which computes the discrimination, the difficulty, and the guessing parameter.[3] For a compact overview, the coefficients are presented in Table 1.

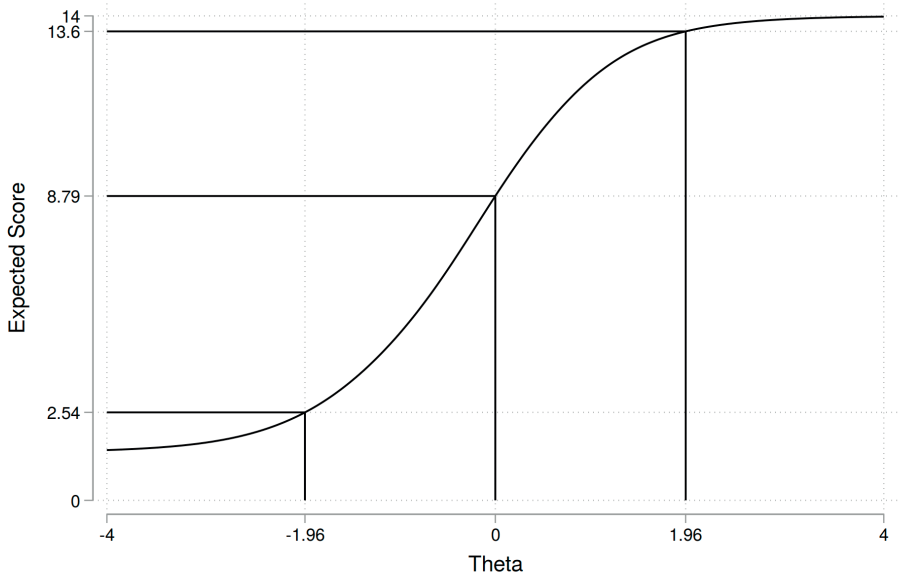
First, the discrimination parameter is discussed. This coefficient is useful to judge how well an item "reacts" to variations in the ability of a respondent. For example, an item with a high discrimination creates a large variation in predicted probability to answer correctly when the ability of the respondents varies. In other words, two individuals with different abilities will have a quite different ability to answer an item correctly when the differentiation is high. This is therefore a desired property, as items with a low differentiation will produce similar probabilities to answer correctly, even when the ability of two respondents is highly unequal. The numbers (Table 1, column *Discrimination*) indicate that this value is fine for all items except for the first one (Mozart), which is not surprising as almost everyone got it correctly. This means that this item will in almost all cases be correct, no matter whether the inherent ability of a respondent is very low or very high, which results in a low differentiation.

Second, the difficulty of an item is of interest. Apparently, the descriptive table gives already a hint of how difficult an item is through the share of correct responses. The first item is seemingly again not a difficult question at all since almost everyone has the correct answer. For the other items, not the absolute value is of interest but rather the variation. A good scale should contain items from the entire range of the spectrum from easy to difficult. Finally, the pseudo guessing parameter was inspected (0.033). The interpretation is that even the least able respondent had a 3.3 % chance to guess correctly on any item due to chance alone. As this value is rather low, we do not expect any bias due to guessing for our model.

We continue with an assessment of the test characteristic curve (TCC), which models the overall relation between ability and probability to score on the test (Figure 2). Note that here we interpret theta as the latent ability or trait of cultural knowledge in the population. The scaling is that a value of zero means an average ability (with respect to the sample), positive values are above average, negative val-

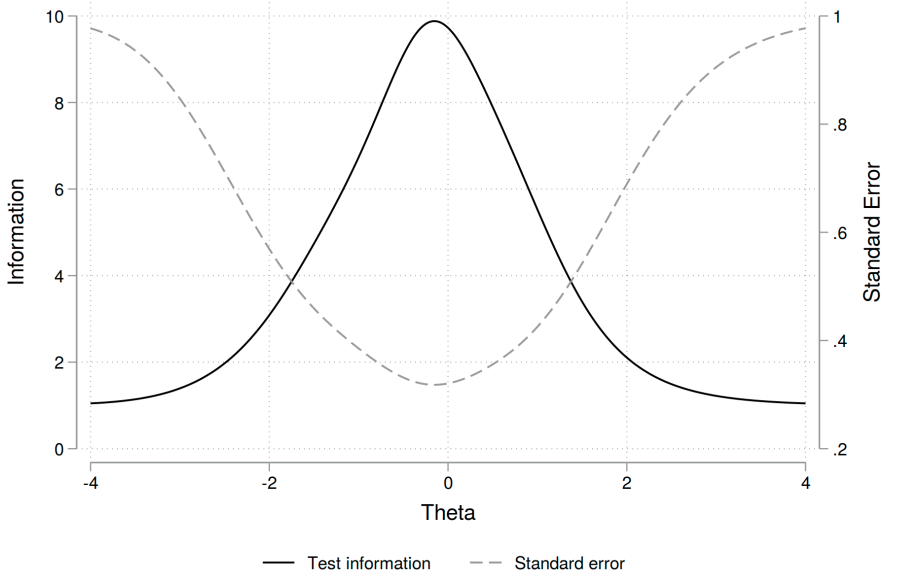
3 Note that we have also tested a 1- and 2- parameter model and compared model fits. As relative measurements of fit, such as the AIC or Likelihood ratio tests were in favor of the 3-parameter model, we only report this one.

Figure 2: Test characteristic curve



Note. NEPS SC6, $N = 7026$.

Figure 3: Test information function



Note. NEPS SC6. $N = 7026$.

ues below average. That is, the larger theta, the larger the cultural knowledge of the participant.

Assuming that theta is normally distributed in the population, one would estimate that the average respondent has about 8.8 correct items in the test. The plotted extra lines give a 95% confidence interval around this mean for the population. The average 95% of respondents around the ability mean will have between 2.5 and 13.6 correct items, on average. This, again, shows that there is little room to differentiate between very high levels of ability, as the ceiling of 14 correct items is rather close.

We continue with the test information function (TIF). The TIF of the instrument is the sum of the information functions of all items. This measure, which is of great practical interest, describes the accuracy to which we can measure the latent ability theta in the sample. In other words, it allows us to assess whether the instrument is able to measure precisely very high or low values of theta. The graph is depicted in Figure 3, the standard error of the function is included as well.

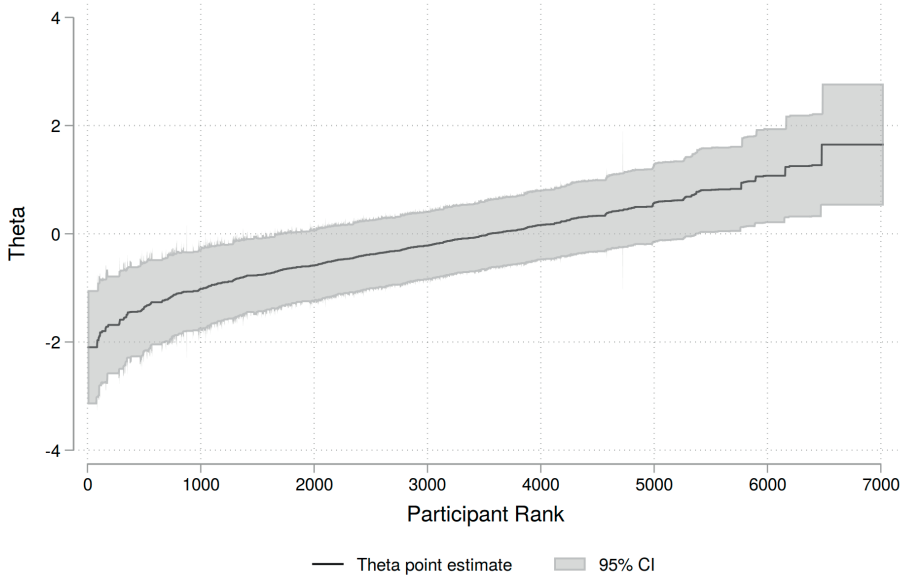
As seen in the graph, the TIF is highly similar to a normal distribution with the maximum value close to zero. This indicates that the instrument provides the highest accuracy for participants with average cultural knowledge but less so in the more extreme regions of the distribution, that is, respondents with very high or very low cultural knowledge. The standard error reflects this, as it is the lowest around the mean and increases the further away theta is from the mean value. Thus, the instrument is suitable for providing a high degree of information for respondents with "average" cultural knowledge, which is a desirable property for a test which is to be applied to the general population where one would assume such average levels of knowledge. In contrast, the instrument would be hardly able to serve as an admission test to a field of study in the cultural studies where one would assume a high level of cultural knowledge of the participants.

4.4 Individual Prediction of Ability

Until now, general properties of the test and the items were scrutinized. In the next step of the analyses looking at individuals in the test was at the center of interest. To do so, a predicted ability score (theta) was computed for each participant. This score is different and much more detailed than the simple sum score presented before, as it takes the difficulty of the items into account. This allows a more precise judgment of the individual abilities. We started with the overall distribution in the sample where participants were ranked by their ability. An analytical 95% confidence interval is included as well (Figure 4).

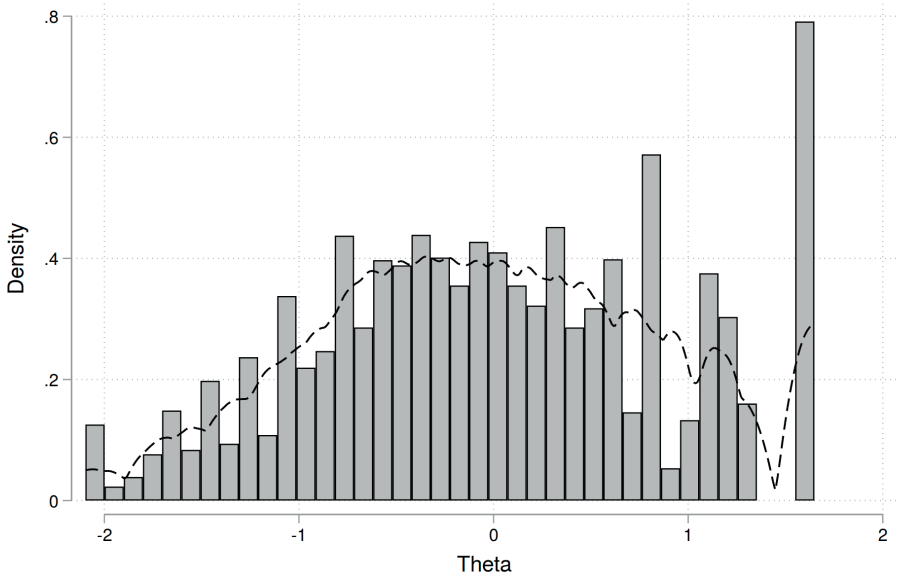
A higher rank indicates a higher ability. We note that the curve is rather smooth except for a few quite distinct steps. Rather outstanding is the plateau to the very right of the graph where all individuals with a perfect score of 14 are grouped together. Since these had all questions correct, it is not possible to further distinguish them, as the order of the items is irrelevant, and the difficulty does not tell them apart. Otherwise, the graph looks fine, and we do not see any disturbing patterns or

Figure 4: Predicted theta ranked



Note. NEPS SC6. Higher ranks stand for a higher knowledge. $N = 7026$.

Figure 5: Distribution of cultural knowledge (theta) in the sample



Note. NEPS SC6. $N = 7026$.

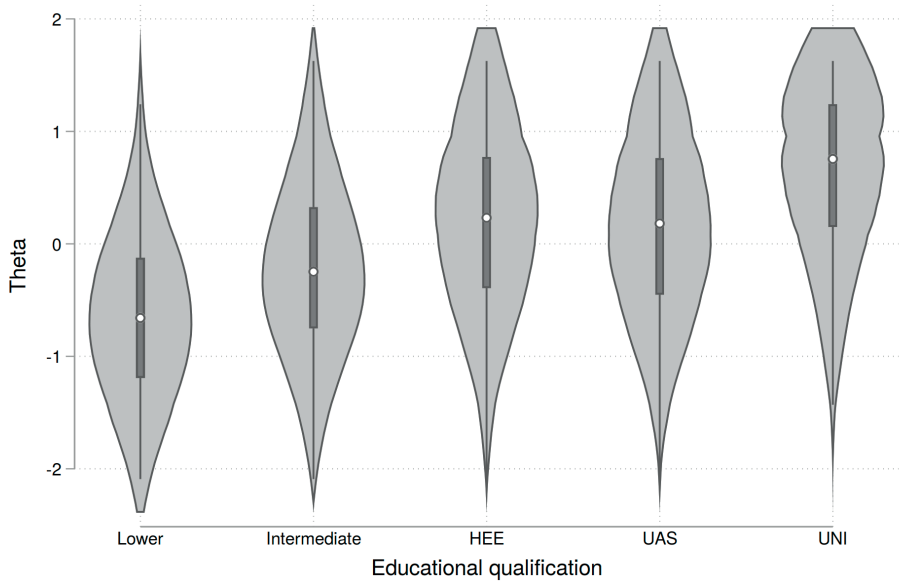
non-linear shapes. We continue with a simple histogram of the overall ability distribution in the sample with a kernel density plot inserted (Figure 5).

The distribution is approximately normal with a few major exceptions. We note a bar higher than expected to the very left, which indicates the group of the least able participants. Much more pronounced is, however, the group of individuals with very high scores on the right. These are, again, the individuals with a perfect score and are thus grouped together with a single value. However, in between, the values are much more normally distributed than the sum score shown above. The conclusion is that the modelling using IRT has advantages over a simple sum score as it is able to reveal much more detail information about the instrument.

4.5 Construct Validity

Finally, it is of greatest interest to judge the construct validity of the scale. Concretely, to answer the question whether the scale actually measures cultural knowledge. While there is no way to do this directly, we can look at expected correlations with other variables. We would expect that individuals with a high general level of education or individuals with the possession of high amounts of cultural capital will also have higher levels of cultural knowledge, on average. This can be evaluated using graphical means and correlation coefficients. We analyzed the correlation between educational qualification, the occupational prestige, EGP classes, age, and

Figure 6: Theta scores by educational attainment (violin plot)



Note. NEPS SC6. Lower = none or lower secondary degree, Intermediate = intermediate degree, HEE = higher education eligibility (*Abitur*), UAS = University of applied science degree, UNI = University degree. *N* = 7025.

cultural capital. The results for educational qualifications, which are the most relevant to us, are visualized using violin plots, which combine boxplots with the actual distribution of theta within each category for a high level of information (Figure 6).

As the median (white dot) shows, the average level of theta rises with education. The highest educational level (university graduates) also shows the highest level of theta, on average. There is little difference between individuals with a university of applied science degree and a higher education eligibility. The other results are summarized in Table 2. The linearity between theta and each variable was inspected visually and approved; hence we assume the findings to be robust. Case numbers can vary slightly due to the availability of the respective correlating variable. We present the point estimate and a 95 % bootstrap confidence interval to assess the statistical significance of each finding (Bittmann, 2021; Efron & Tibshirani, 1994). The intervals can be used to judge the precision of the point estimate. For continuous variables Pearson's r was computed, for the other variables Spearman's rho.

Table 2: Correlation analysis between cultural knowledge (theta) and various socio-demographic variables

Correlating variable	*N*	Point estimate	95 % CI
Educational level (5 groups)	7025	.465*	.445; .482
EGP classes (3 groups)	6011	.311*	.287; .333
MPS	6140	.362#	.339; .383
Age in 2020	7026	.264#	.241; .286
Cultural capital	6863	.574#	.558; .590

Note. NEPS SC6. * Spearman's rho. # Pearson's *r*. BC CIs are based on 1000 bootstrap resamples. For example, the correlation between cultural knowledge (theta) and the educational level of the participants is 0.465. As the CI excludes 0, this correlation is statistically significant on the 5 % level.

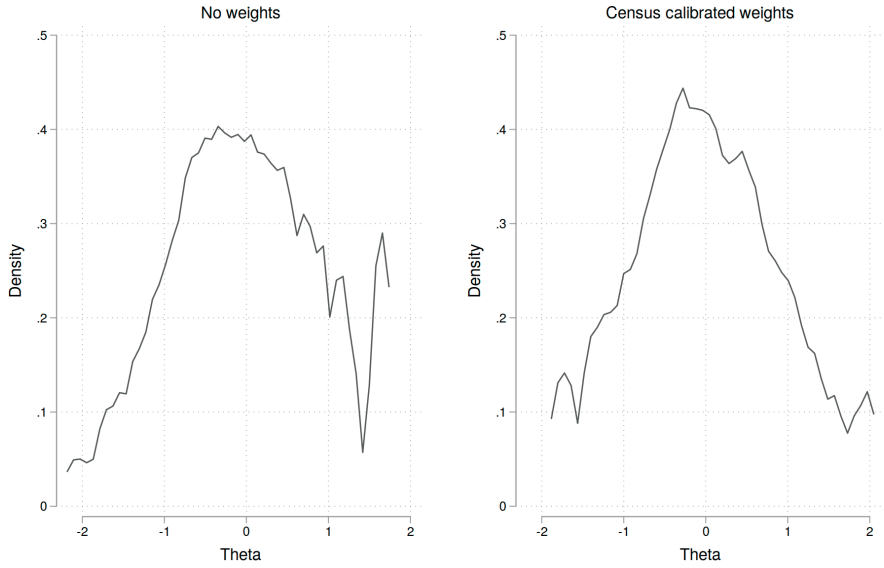
Note that missingness is mostly due to elder participants who no longer are active in the labor market and no occupation was available for the computation of the relevant statistic. For individuals who retired within the last six years, the information (MPS or EGP) was imputed from the last occupation held. All point estimates are positive, and the confidence intervals (CIs) never include 0, indicating that these associations are statistically significant on the 5 % level. The size of each coefficient is considerable, the strongest associations are found for cultural capital and the educational level. According to Cohen (1988), values above .50 can be regarded as strong correlations. These findings are plausible, as individuals who possess a lot of cultural capital expectedly also have a higher knowledge about these aspects. They are more interested in the domain and spent more time and money on them, for example, by reading more and visiting museums or theatres more often. Obviously,

these individuals will possess more knowledge as they are better informed. Also, older participants have higher theta scores as the increase is highly linear. When the bivariate association is investigated, individuals around age 40 have a mean value of -.40, while older ones around age 70 have values of .20.

4.6 Robustness Checks

By now, we have demonstrated that the construct validity in the realized sample is high, that is, knowledge correlates well with other relevant variables. However, what is slightly more concerning is the distribution of the predicted ability (theta) since it is not normal, and a ceiling effect is present. This is an undesirable property of the current scale. However, this must be put into perspective as the realized NEPS sample in wave 12 is not representative of the overall German population but much more selective due to the long-running panel. It is well known that panel attrition can lead to unbalanced and highly selective samples, which is the case here. As we see in Table A2 in the appendix, the realized sample is much more educated, on average, than the average German. We have used Census calibrated weights to demonstrate this. In the realized sample, the share of individuals with a university degree is about 20 %; when the weights are applied it drops to only 7.7 %. The same holds for the MPS, showing that the average prestige in the sample is much higher than in the population. This is a problem for evaluating the scale, as the knowledge

Figure 7: Distribution of theta in the unweighted and weighted sample



Note. NEPS SC6. $N = 7026$.

in the sample is probably much higher than in the population, which might contribute to the emergence of the ceiling effect. To test this, the IRT models were recomputed using provided weights to check which distribution appears if the NEPS had a more representative sample. The findings are visualized with kernel density plots in Figure 7.

On the left side predicted theta for the realized sample is shown, which reveals the same picture as the histogram shown before (Figure 5). On the right side, the Census calibrated weights are applied. The conclusion is that the ceiling effect is drastically reduced, which is plausible. If the highly educated individuals in the sample receive fewer weight, their influence decreases. The distribution then looks much more normal, while small bottom and ceiling effects are present. We can conclude that the new scale is robust and will give better results if applied in the overall population. Only in samples of highly educated individuals its usage might lead to the emergence of ceiling effects.

5. Discussion

The aim of this paper was to introduce a new instrument to measure cultural capital in the overall population. First, we evaluated Bourdieu's concept of cultural capital and cultural knowledge and used this as the foundation of the items. By doing so, we defined which aspects of highbrow cultural knowledge are relevant and why. The following statistical analyses showed that the instrument and derived scale are of high quality. Overall, almost all items contribute to the quality (with a single exception). Further tests ensured that the scale has desirable properties and is approximately normally distributed in the sample. In this context, it is important to note that this is a measurement of *knowledge* and not of *participation* in highbrow activities (like reading books or visiting the opera). Instruments measuring these aspects already exist, e.g., in large population studies such as the NEPS, the German General Social Survey (ALLBUS/GGSS), the German Socio-Economic Panel (SOEP), or smaller ones such as the *Kulturbarometer* of the Center for Cultural Research. Instead, our instrument offers the possibility to answer questions that have already been partly raised in the literature review: Especially questions related to social reproduction, social mechanisms and educational opportunities seem to be well addressable with this instrument. How are high cultural knowledge and labor market positioning related? What role does the signaling effect of cultural knowledge play in educational success? Does cultural knowledge continue to represent a distinctive feature? What does high cultural knowledge mean for ethnic inequalities? We believe that our instrument helps to answer these and related questions.

However, of course there are certain aspects that should be taken into account when using the instrument: The first big caveat is that our sample, while large, is not quite representative of the overall German population, due to the nature of the long-running panel. While we cannot adjust the sample, we provide results comput-

ed using census calibrated sampling weights to account for this issue. By doing so, we showed that the results approach a normal distribution. Taking this finding into account leads to the assumption that the resulting scale would presumably be normally distributed in a random sample of the German population. Consequently, the instrument can be applied in general population surveys. However, and this is the second caveat, the instrument is expectably not adequate for special populations, for example, populations with very high highbrow cultural knowledge, since it is not able to differentiate to a high degree. If the instrument should be applied to these extreme populations, adding even more difficult items might be useful; the same holds for groups with very little cultural knowledge.

The third caveat is that the instrument has been developed for a German and German-speaking population. This is clear from the selection of items that concern, for example, composers or authors, that were German or highly relevant in the German (schooling) system. Consequently, translating the instrument and using it in different populations might lead to very different results and should only be attempted with great caution.

Fourth, as we tried to make clear throughout the paper, the instrument only applies to highbrow culture and does not claim to measure "overall" cultural knowledge. Culture is a very broad construct with a magnitude of different aspects. Given the required brevity of a construct that can be applied in a general survey, it is not feasible to consider the entire, thousands of years spanning human culture. Consequently, the current instrument focuses on a rather narrow definition of highbrow culture that is relevant for the German context. All potential users of this instrument must be aware of this.

Finally, as outlined before, there is a single item that showed, statistically speaking, a very bad fit (Mozart). As almost all respondents knew the correct answer, this item cannot contribute much to the scaling process. However, we believe that this item has a more psychological function in the survey context, as it is the first item and gives all respondents the impression that they will be able to handle the following questions. By starting with a very simple "icebreaker" question, this might influence participation rates positively. When calculating scales and statistics, users might want to remove this item afterwards.

6. Conclusion

In this contribution, we have presented a new scale to measure highbrow cultural knowledge in the population. As our statistical analyses have demonstrated, the 14 items can be utilized to create an approximately normally distributed knowledge score. There is good evidence for a high reliability and internal consistency of the construct. The following tests have shown that this score correlates highly with other related constructs, like level of education or cultural capital. Our conclusion is hence that the construct indeed measured this form of cultural knowledge

and therefore fulfils the expectations. The scale is freely available for non-commercial research. However, since our focus is limited to only one dimension of cultural knowledge, we strongly encourage other researchers to develop instruments on further dimensions.

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Appendix

Table A1: Complete instrument

#	German original	English translation
1	Nun werde ich Ihnen eine Reihe von Personen nennen. Sagen Sie mir bitte, ob die jeweilige Person ein Maler, Schriftsteller oder Komponist war. Falls Sie die Antwort nicht wissen, dann geben Sie einfach „weiß nicht“ an. ... Wolfgang Amadeus Mozart, war das ein Maler, Schriftsteller oder Komponist? [Komponist]	Now I will name a number of people. Please tell me if the person in question was a painter, writer or composer. If you don't know the answer, just enter “don't know”. ... Wolfgang Amadeus Mozart, was he a painter, writer or composer? [composer]
2	... Hermann Hesse [Schriftsteller]	... Hermann Hesse [writer]
3	... Peter Paul Rubens [Maler]	... Peter Paul Rubens [painter]
4	... Giacomo Puccini [Komponist]	... Giacomo Puccini [composer]
5	... Paul Klee [Maler]	... Paul Klee [painter]
6	... Gioachino Rossini [Komponist]	... Gioachino Rossini [composer]
7	... Caspar David Friedrich [Maler]	... Caspar David Friedrich [painter]
8	... Georg Büchner [Schriftsteller]	... Georg Büchner [writer]
9	... Carl Maria von Weber [Komponist]	... Carl Maria von Weber [composer]
10	... Clemens Brentano [Schriftsteller]	... Clemens Brentano [writer]
11	Im Folgenden werde ich Ihnen einige Werke aus den Bereichen Literatur, Kunst und Oper nennen. Sagen Sie mir bitte, von wem das jeweilige Werk ist. Falls Sie die Antwort nicht wissen, dann geben Sie einfach „weiß nicht“ an. ... von wem ist die Oper „La Traviata“? (1) Vincenzo Bellini (2) Antonio Vivaldi (3) Gaetano Donizetti (4) Giuseppe Verdi	In the following I will give you some works from the fields of literature, art and opera. Please tell me who wrote the work in question. If you don't know the answer, simply enter “don't know”. ... who wrote the opera “La Traviata”? (1) Vincenzo Bellini (2) Antonio Vivaldi (3) Gaetano Donizetti (4) Giuseppe Verdi
12	... von wem ist die Oper “Carmen”? (1) Claude Debussy (2) Maurice Ravel (3) Georges Bizet (4) Frederic Chopin	... who wrote the opera “Carmen”? (1) Claude Debussy (2) Maurice Ravel (3) Georges Bizet (4) Frederic Chopin
13	... von wem ist das Gemälde “Guernica”? (1) Georges Braque (2) Pablo Picasso (3) Joan Miró (4) Francisco de Goya	... whose paining is “Guernica”? (1) Georges Braque (2) Pablo Picasso (3) Joan Miró (4) Francisco de Goya
14	... von dem ist das Gemälde “Der Schrei”? (1) Max Liebermann (2) Christian Gottlieb Schick (3) Max Beckmann (4) Edvard Munch	... whose painting is “The Scream”? (1) Max Liebermann (2) Christian Gottlieb Schick (3) Max Beckmann (4) Edvard Munch

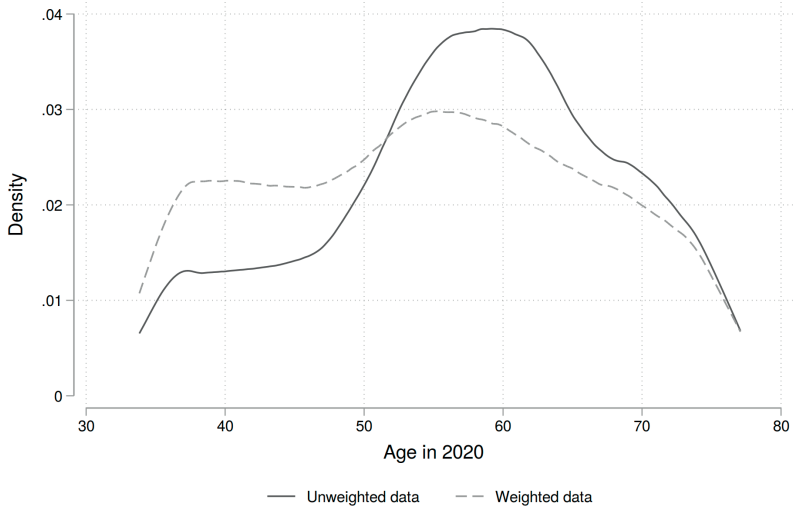
Note. NEPS SC6. Correct answers are given in brackets (items 1–10) or are underlined (items 11–14). For an implementation in a survey see https://www.neps-data.de/Portals/0/NEPS/Datenzentrum/Forschungsdaten/SC6/Feldversionen/SC6_w12.pdf

Table A2: Descriptive statistics

	Unweighted sample			Census weighted sample		
	N	*Mean*	*SD*	*N*	*Mean*	*SD*
Female participant	7026	0.51	0.50	7026	0.50	0.50
Age in 2020	7026	57.4	10.5	7026	54.7	11.6
Migration background	7026	0.16	0.36	7026	0.27	0.45
Educational qualification						
None or lower	7025	0.18	0.39	7025	0.29	0.45
Intermediate	7025	0.32	0.47	7025	0.40	0.49
HEE	7025	0.19	0.39	7025	0.19	0.40
UAS	7025	0.11	0.31	7025	0.041	0.20
UNI	7025	0.20	0.40	7025	0.077	0.27
EGP class						
Working class	6011	0.21	0.41	6011	0.33	0.47
Middle class	6011	0.24	0.43	6011	0.29	0.45
Service class	6011	0.55	0.50	6011	0.39	0.49
Current or former MPS	6140	88.3	39.9	6140	74.7	36.0
Currently employed	7026	0.74	0.44	7026	0.73	0.44
Living in East Germany	6887	0.21	0.40	6887	0.20	0.40

Note. NEPS SC6. None or lower = none or lower secondary degree, Intermediate = intermediate degree, HEE = higher education eligibility (*Abitur*), UAS = University of applied science degree, UNI = University degree.

Figure A1: Age distribution in the sample



Note. NEPS SC6. *N* = 7026.