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As You Sow, So Shall You Reap: Gender-Role Attitudes and Late-Life Cognition

Eric Bonsang[1,2,3], Vegard Skirbekk[3,4], and Ursula M. Staudinger[3]

[1]Laboratoire d'Economie de Dauphine, Université Paris-Dauphine, PSL Research University; [2]Department of Living Conditions, Luxembourg Institute of Socio-Economic Research, Esch-sur-Alzette, Luxembourg; [3]Robert N. Butler Columbia Aging Center, Mailman School of Public Health, Columbia University; and [4]Centre for Fertility and Health, Norwegian Institute of Public Health, Oslo, Norway

Abstract

Some studies have found that women outperform men in episodic memory after midlife. But is this finding universal, and what are the reasons? Gender differences in cognition are the result of biopsychosocial interactions throughout the life course. Social-cognitive theory of gender development posits that gender roles may play an important mediating role in these interactions. We analyzed country differences in the gender differential in cognition after midlife using data from individuals age 50 and above (N = 226,661) from 27 countries. As expected, older women performed relatively better in countries characterized by more equal gender-role attitudes. This result was robust to cohort differences as well as reverse causality. The effect was partially mediated by education and labor-force participation. Cognition in later life thus cannot be fully understood without reference to the opportunity structures that sociocultural environments do (or do not) provide. Global population aging raises the importance of understanding that gender roles affect old-age cognition and productivity.

Keywords

cognition, later life, gender-role attitudes, country differences

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Traditionally, gender differences in cognition have been studied and heatedly debated with regard to children and adolescents (Guiso, Monte, Sapienza, & Zingales, 2008; Hyde & Mertz, 2009; Reilly, 2012). More recently, in the context of population aging, more researchers have begun investigating gender differences in cognitive functioning during adulthood and old age. Studies from Western countries have documented that men tend to outperform women on tasks requiring visuospatial processing and categorical fluency, whereas women show an advantage on many episodic memory tasks and a variety of speeded tasks, including word fluency, digit-symbol substitution, letter identification, and picture identification (e.g., Deary, Whiteman, Starr, Whalley, & Fox, 2004; Gerstorf, Herlitz, & Smith, 2006; Ho, Woo, Sham, Chan, & Yu, 2001; Meinz, 1998; Read et al., 2006). Studies conducted in non-Western societies, such as China and India, however, have reported a disadvantage for older women compared with men in measures of episodic memory and word fluency (Lei, Smith, Sun, & Zhao, 2014; Onur & Velamuri, 2016).

Can psychology help to clarify such seemingly contradictory results? We argue that it can. First, this is because psychological research has demonstrated that human, in this case cognitive, development is not biologically determined but rather the result of cumulative interactions between biology and sociocultural context and is lifelong (Baltes, Lindenberger, & Staudinger,

Corresponding Author:
Eric Bonsang, Université Paris-Dauphine, PSL Research University, Laboratoire d'Economie de Dauphine, Place du Maréchal de Lattre de Tassigny, Paris, Ile-de-France 75775, France
E-mail: eric.bonsang@dauphine.fr

2006). Second, research has specified social-cognitive and behavioral mechanisms that allow such interactions to be unraveled (Bussey & Bandura, 1999; Miller & Halpern, 2014; Wood & Eagly, 2002). In order to tease apart such influences, country comparisons are necessary and systematic causal analysis is required.

Studies that have approached the question of potential societal determinants of gender differences in cognition after midlife tend to (a) focus on socioeconomic factors and economic development and (b) disregard the question of causal direction (Lei, Hu, McArdle, Smith, & Zhao, 2012; Weber, Skirbekk, Freund, & Herlitz, 2014; Yount, 2008). Thus, little is known about the causal impact of sociocultural factors such as gender-role attitudes on women's cognitive performance in later life, even though major psychological theories of gender differences in behavior have pointed to the importance of such attitudinal factors in regulating gender-specific behavior (cf. Bussey & Bandura, 1999; Wood & Eagly, 2002). Gender roles prescribe which types of behaviors, activities, and attributes a given society considers appropriate for men and women (e.g., Wood & Eagly, 2002). In line with this theorizing, we propose that gender-role attitudes cumulatively impact women's cognitive functioning by influencing their life goals and expectations as well as their exposure to cognitively stimulating tasks during the life course, including education and economic activities. Thus, gender-role attitudes may play an important role in the biopsychosocial influences on gender differences in cognition (Miller & Halpern, 2014). This study is the first to investigate the effect of gender-role attitudes in shaping gender differences in cognitive functioning after midlife across countries and cohorts.

Cognitive Performance in Later Life

Negative age-related differences in one important component of cognitive functioning—fluid abilities—have been well documented: A large amount of evidence suggests that the speed of new information processing, executive control of thought processes, and episodic memory decreases as age increases (Baltes et al., 2006; Dixon, Bäckman, & Nilsson, 2004; Salthouse, 2014).

However, there are great interindividual differences in the level of cognitive performance after midlife, and it has been demonstrated that such levels show plasticity; that is, age-related cognitive differences are modifiable depending on the available resources (Baltes et al., 2006; Staudinger, 2015). Several types of resources have been identified to support brain plasticity (Hertzog, Kramer, Wilson, & Lindenberger, 2008). Higher levels of cognitive functioning and lower degrees of neuropathology have been found to result from longer education (Falch & Sandgren Massih, 2011; Schneeweis, Skirbekk, & Winter-Ebmer, 2014; Williams, Plassman, Burke, Holsinger, & Benjamin, 2010). Later-life cognition has also been shown to be positively related to labor-force participation (e.g., Bonsang, Adam, & Perelman, 2012), type of occupation and job-task content (Oltmanns et al., 2017; Schooler, Mulatu, & Oates, 1999), leisure activities (Newson & Kemps, 2005; Scarmeas, Levy, Tang, Manly, & Stern, 2001), and lifestyle (e.g., Fratiglioni, Paillard-Borg, & Winblad, 2004; Hertzog et al., 2008).

Gender Differences in Cognitive Performance in Later Life

There is some consistency across studies showing that women outperform men on measures of episodic memory (Herlitz & Rehnman, 2008). Findings on category fluency tasks (in contrast to word-beginnings fluency tasks) show, in contrast, a slight advantage for men, although this advantage is of a smaller magnitude than the advantage of women for episodic memory (e.g., Barrett-Connor & Kritz-Silverstein, 1999; Gerstorf et al., 2006). There is evidence that men have an advantage on visuospatial tasks (Herlitz & Rehnman, 2008), although the findings are less clear for calculation and numeracy tasks (e.g., Barrett-Connor & Kritz-Silverstein, 1999). But all in all, results on gender differences in cognition (even within one country) after midlife are even less unequivocal than those on gender differences in childhood, which points to the cumulative differentiating effect of biopsychosocial interactions. Biological factors such as prenatal androgens can influence how individuals select environments, and these environments can then cause further biological development (cf. Miller & Halpern, 2014). Biology and environment are closely intertwined and continuously influence each other (Baltes et al., 2006). Cultural factors such as gender-role attitudes can even reverse these sex differences in particular contexts and nations (Reilly, 2012).

Gender-Role Attitudes

Gender-role attitudes are likely to affect the way men and women, over the life course, engage in education, labor-force participation, and other occupations that have been demonstrated to buffer against cognitive decline. Conceptually, gender-role attitudes influence women's behavior through two mechanisms. First, gender-role attitudes influence gender identity, that is, a person's gender-related sense of self. Gender identity has been recognized as one driver of many individual decisions and outcomes through its influences on beliefs (i.e., priors) and values (i.e., preferences), which

can include behaviors affecting cognitive performance over the life course. In an environment where the expectation is that a man should work in the labor force and a woman should be a housewife, female gender identity implies that women should not outperform men. This, in turn, will likely affect female relative to male behavior and performance in school and at work (cf. Bussey & Bandura, 1999; Wood & Eagly, 2002, 2012).

Second, gender-role attitudes influence the design of formal institutions, such as the legal system, and regulations in the labor market, which constrain or incentivize individuals' choice sets and, in turn, most likely affect cognition in later life (Wood & Eagly, 2012). Societies characterized by traditional gender-role attitudes tend not to promote and even to hamper gender equality (e.g., legislation about maternity leave, antidiscrimination, and gender differences in mandatory retirement age). Thus, women may face barriers to access education or the labor market, independently of their own beliefs or preferences. And, indeed, there is empirical evidence that gender equity relates to education and labor-market access (Miller & Halpern, 2014). Several studies have indeed found that traditional gender-role attitudes on a country level are associated with substantial reductions in female educational participation and in women's chances in the labor market (Fortin, 2005).

On the basis of such evidence and considerations, we expected that women living in a society characterized by traditional gender-role attitudes would have less opportunity to participate in education and the labor market across the life course, which will yield lower cognitive performance later in life relative to age-matched men.

Method

Sample and procedure

We used data from surveys that included comparable cognitive test scores for nationally representative samples of individuals age 50 and above. The included surveys were the U.S. Health and Retirement Study (HRS, 2016); the Survey of Health, Ageing and Retirement in Europe (SHARE, 2017); the English Longitudinal Study of Ageing (ELSA; Marmot et al., 2017); and the World Health Organization Study on Global AGEing and Adult Health (SAGE; World Health Organization, 2016). SHARE is a panel database of individuals age 50 or over from 19 European countries (Sweden, Denmark, Estonia, Germany, Poland, The Netherlands, Belgium, Luxembourg, France, Austria, Czech Republic, Switzerland, Italy, Greece, Spain, Portugal, Slovenia, Hungary, and Ireland) and Israel.[1] Because conceptually comparable information is collected and procedures are synchronized to the extent possible among SHARE, HRS, and ELSA, we also included the United States and England. SAGE is a survey based on a nationally representative sample of individuals age 50 and above in China, Ghana, India, Mexico, Russia, and South Africa.

The analytical sample contained data from respondents between the ages of 50 and 93 years and born between 1920 and 1959 who had available cognitive test scores.[2] For SHARE, we combined data from the 1st and 2nd waves (conducted from 2004 to 2005 and 2006 to 2007) and the 4th and 5th waves (conducted from 2010 to 2011 and in 2013). Given the panel structure of the SHARE data, some individuals have been tested several times. Thus, we also carried out the analysis by restricting it to respondents who performed the cognitive test for the first time only. The results were largely consistent with those presented in the Results (see Tables S1, S2, and S3 in the Supplemental Material available online). For HRS, we used the 10th wave, which was carried out in 2010. For ELSA, we used the 4th wave, which was carried out in 2009. Regarding SAGE, we used data from the first wave, which were collected between 2007 and 2010. In total, the sample included 226,661 observations from 27 countries. Table 1 presents the total number of observations by country and cohorts.

Measures

Cognitive performance. All surveys measured cognitive performance by employing tests of episodic memory using the respective national language. In the *episodic memory task*, the interviewer read a list of 10 words, and participants were asked to recall as many words as they could remember in 1 min (immediate recall). After a short interval, the delayed-recall measurement followed. The procedure for SAGE was slightly different: Respondents were given three trials for immediate word recall. For our analysis, we used the score of the first trial to ensure comparability across surveys. For the *category fluency task*, respondents had to name as many different animals as possible in 1 min. This test was not implemented in the HRS. For the main analysis, we therefore decided to focus on immediate word recall and report all results for delayed recall and executive functioning in the Supplemental Material.

Gender-role attitudes. We classified countries (and cohorts) according to responses to a question on gender-role attitudes from the World Values Surveys (WVS), a data set specifically designed for cross-national comparison of values and norms. The WVS questionnaire contains several

Table 1. Sample Size by Country and Cohort

	Birth years			
Country	1920–1939	1940–1949	1950–1959	Total
Austria	3,552	4,146	3,231	10,929
Belgium	5,480	5,146	5,448	16,074
China	3,507	3,786	5,108	12,401
Czech Republic	3,581	5,220	4,498	13,299
Denmark	2,785	3,367	3,283	9,435
Estonia	3,878	3,687	3,605	11,170
France	5,183	4,611	4,775	14,569
Germany	3,949	4,035	3,403	11,387
Ghana	1,458	1,250	1,473	4,181
Greece	2,146	1,824	1,435	5,405
Hungary	703	965	1,164	2,832
India	1,625	2,326	2,495	6,446
Ireland	366	390	303	1,059
Italy	4,453	4,886	3,209	12,548
Luxembourg	286	424	671	1,381
Mexico	860	877	411	2,148
The Netherlands	3,505	4,473	3,472	11,450
Poland	1,299	1,375	1,324	3,998
Portugal	477	708	687	1,872
Russia	1,335	974	1,221	3,530
Slovenia	1,502	1,628	2,036	5,166
South Africa	1,015	1,280	1,300	3,595
Spain	4,968	4,060	3,716	12,744
Sweden	4,225	4,668	2,495	11,388
Switzerland	2,626	2,911	2,843	8,380
United Kingdom	3,586	3,660	2,870	10,116
United States	6,759	5,078	7,321	19,158
Total	75,109	77,755	73,797	226,661

Note: Data were drawn from the U.S. Health and Retirement Study (HRS); the Survey of Health, Ageing and Retirement in Europe (SHARE); the English Longitudinal Study of Ageing (ELSA); and the World Health Organization Study on Global AGEing and Adult Health (SAGE).

questions that quantify individuals' attitudes about gender roles, which allowed us to compute gender-related attitudes separately for each country and cohort. Among the items available for all countries, there are some indicative of normative values, such as the way children should be raised or the trade-off between taking care of the home or working for pay, but they do not explicitly describe the hierarchical dimension of the male-female relationship. Therefore, we decided to focus on the one item that was asked to the largest number of individuals in all the countries under study and that explicitly evokes a hierarchical relationship between men and women: "When jobs are scarce, men should have more right to a job than women." Respondents were asked to choose among *agree, neither*, and *disagree*. We computed a dummy variable equal to 1 when the individual agreed with the statement and 0 otherwise.

Depending on the model specification described in the following section, we calculated the proportion of individuals born between 1920 and 1959 who agreed with this statement by country or by country and cohort (cohort born between 1920 and 1939, between 1940 and 1949, and between 1950 and 1959) and merged it with our analytical sample either at the country level or at the country-cohort level. Sampling weights were used for each cohort by country so that our measure was representative of our target population (cohorts born between 1920 and 1959). The proportion of people who agreed with the statement can be interpreted as the degree of traditionalism with regard to gender

roles. It is in this sense that we will be using the phrase *traditional gender-role attitudes*.

Statistical analyses

We first conducted analyses across countries in which we linked female relative advantage in cognitive test scores with the measure of gender-role attitudes.[3] We calculated the relative female advantage in cognitive test score by defining C_{fi} and C_{mi} as the average cognitive test score of females (f) and males (m), respectively, born between 1920 and 1959 in country i. The relative female advantage in cognitive test score in country i (ΔC_i) was equal to $(C_{fi} - C_{mi})/C_{mi}$. Ordinary-least-squares regression was used to estimate this association while controlling for region (i.e., continent) and for economic development, approximated by the gross domestic product (GDP) per capita in 2010 (obtained from World Development Indicators of The World Bank, 2017).

Next, we identified the relationship between gender-role attitudes and the relative female advantage in cognition (ΔC_{it}) across cohorts within countries. Thus, we controlled for unobserved cross-country heterogeneity and for unobserved cohort heterogeneity that may be associated with gender differences in cognition and gender-role attitudes. We estimated the following equation:

$$\Delta C_{it} = \alpha_i + \lambda_t + \beta GR_{it} + \varepsilon_{it}, \quad (1)$$

where ΔC_{it} is the relative female advantage in cognitive test score of cohort t from country i, α_i is the country fixed effect, λ_t is the cohort fixed effect, GR_{it} is the measure of gender-role attitudes for the cohort t in country i, ε_{it} is an idiosyncratic error term, and β is the parameter of interest. This parameter was identified because countries have experienced different cohort-related variations in gender-role attitudes.

We defined three cohorts: (a) born 1950 to 1959, (b) born 1940 to 1949, and (c) born 1920 to 1939. We chose a longer range for the oldest cohort to ensure the accuracy of our estimates. Also, it is reasonable to assume that changes in gender-role attitudes happened more slowly for those cohorts. The number of observations for each cohort was approximately equal (see Table 1).

Instrumental-variable approach. Because more traditional gender-role attitudes may also arise in countries where women perform less well to start with, we applied an instrumental-variable approach. In nonexperimental studies, instrumental-variable estimators can be used to uncover causal effects in the presence of reverse causality (or omitted variable bias or measurement error). A valid instrumental variable induces changes in the treatment variable (in our case, gender-role attitudes) but has no independent effect on the dependent variable (in our case, gender differences in cognition), except through the treatment variable (Kenny, Kashy, & Bolger, 1998). We used country differences with regard to whether Protestants were the dominant religious group as an instrumental variable for gender-role attitudes across countries. In particular, we measured the proportion of individuals who were Protestant in a given country. The data on religious affiliation were derived from the World Religion Database (Johnson & Grim, 2010).

The choice of this instrument was motivated as follows. First, religion has an important influence on identity formation (Castells, 2003). Secondly, the Catholic and Protestant churches have long shared the same norms for a traditional model of the family and a clear gender division at home and in society at large. However, during the 20th century, Protestant churches appear to have changed their position concerning the role of women to a greater extent than the Catholic church. For instance, an increasing number of Protestant churches have been accepting women into the clergy (Korpi, 2000). Among major religious groups, Protestantism has in several studies been found to be the one least likely to emphasize traditional gender roles (Hoffmann & Miller, 1997). Furthermore, reverse causality (in which Protestantism should result from gender differences in cognition) is less likely to be an issue than in the case of gender-role attitudes. It seemed reasonable to assume that differences in the prevalence of Protestantism among countries are unrelated to gender differences in cognition, except through the effect of Protestantism on gender-role attitudes. (An alternative identification strategy is proposed in the Supplemental Material. The results, presented in Table S5, are consistent with our main results.)

Mediating mechanisms. We hypothesized that education and labor-force participation may mediate the effect of gender-role attitudes on late-life cognition. Therefore, we performed analyses at the individual level and controlled for respondents' educational attainment and for labor-market participation during the life course. Educational attainment was measured with a categorical variable: no education, primary education, secondary education, and more than secondary education. (We also added a dummy variable equal to 1 if education level was missing; 1.7% of the full sample.) Labor-market participation during the life course was approximated by a dummy variable that was equal to 1 when the individual reported having never worked and 0 otherwise. (We also added a dummy variable equal to 1 if this information was missing; 0.53% of the full sample.) We chose to use

this proxy because it was available for all the surveys used in the analysis. More detailed information about labor-market history was not available for all surveys.

The individual-level analysis was based on the cross-country variation in gender-role attitudes.[4] We estimated the following equation:

$$C_{ic} = \delta_0 + \sum_{C=1}^{C-1} \delta_{1\_c}\ \text{country}_c + \delta_1\ \text{woman}_{ic} + \delta_2\ \text{Asia}_c \times \text{woman}_{ic} + \delta_3\ \text{Africa}_c \times \text{woman}_{ic} + \delta_4\ \text{America}_c \times \text{woman}_{ic} + \delta_5\ \text{woman}_{ic} \times \text{GR}_c + \eta_{ic}, \quad (2)$$

where C_{ic} is the normalized cognitive test score (with a mean of 0 and standard error of 1 at the country level) of individual i living in country c; country_c is the country dummy that captures any source of common cross-country variations in cognitive test scores; Asia_c, Africa_c, and America_c are the continent dummies (Europe being the reference category); woman_{ic} is a dummy equal to 1 if the individual was a woman; GR_c is the measure of gender-role attitudes for country c; and η_{ic} is the idiosyncratic error term. We used clustered standard errors at the country level to account for within-country error correlation.

We also performed the microlevel analysis when using the cross-country cross-cohort approach. This additional robustness check is documented in the Supplemental Material (the model is explained by Equation S1, and results are presented in Table S6). The results were consistent with the ones reported in this article.

Results

As expected (see Fig. 1), the relative female advantage in immediate word recall varied significantly across countries. Results for delayed word recall and word fluency replicated these findings (see Fig. S1 in the Supplementary Material). Gender differences in cognitive performance vary widely across countries. The relative female advantage varied from −7.1% for Ghana to +10.5% in Sweden (higher numbers indicate a greater advantage for women).

Supporting our hypotheses, Figure 1 shows a strong negative association between the degree of traditionalism displayed in gender-role attitudes and the relative female

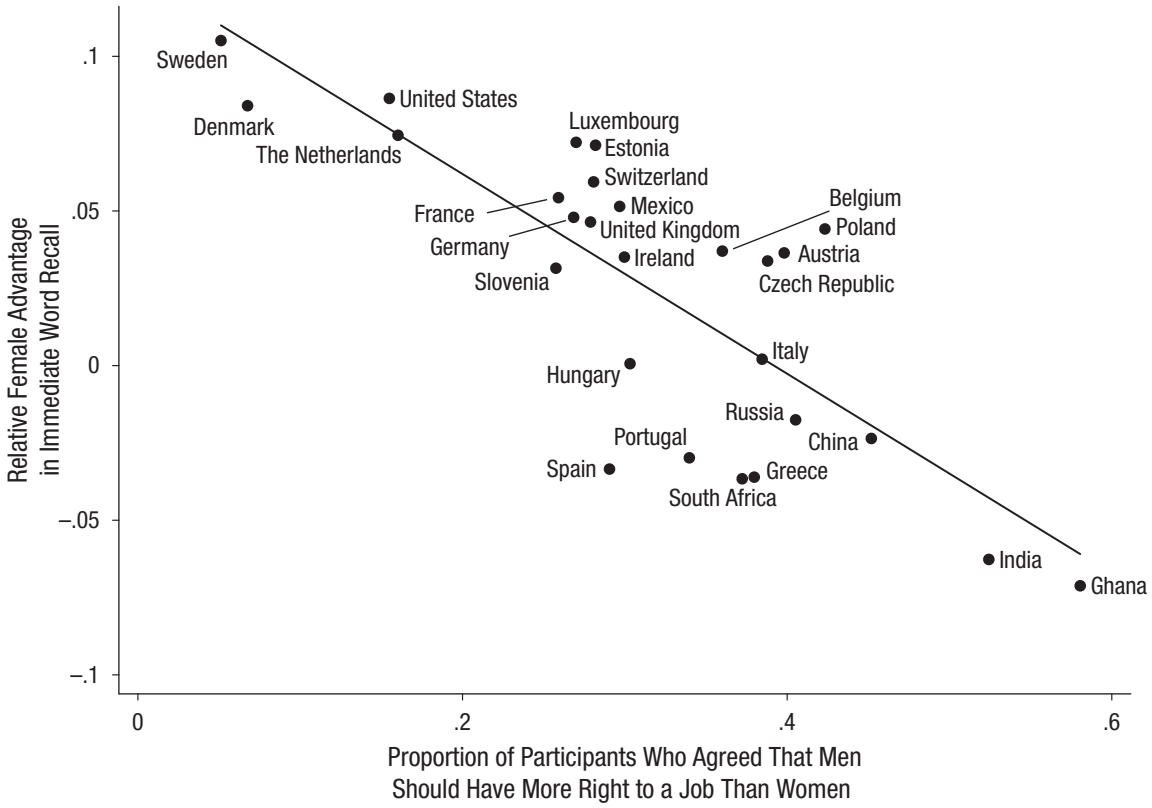

Fig. 1. Scatterplot (with best-fitting regression line) showing the association between relative female advantage in immediate word recall and proportion of individuals born between 1920 and 1959 who agreed with a statement that men should have more right to a job than women when jobs are scarce. Results are shown separately for each of the 27 countries included in the analysis.

Table 2. Results of the Regression Analyses Predicting Relative Female Advantage in Immediate Word Recall

	Relative female advantage in immediate word recall		
Predictor	Model 1	Model 2	Model 3
Traditional gender-role attitudes	−0.323**	−0.242**	−0.215**
	(0.048)	(0.060)	(0.067)
Log (gross domestic product per capita)			0.008
			(0.008)
Region: America		0.017	0.022
		(0.022)	(0.022)
Region: Asia		−0.029	−0.019
		(0.021)	(0.023)
Region: Africa		−0.045†	−0.033
		(0.024)	(0.027)
Intercept	0.127**	0.106**	0.021
	(0.016)	(0.018)	(0.093)
R^2	.640	.706	.718

Note: The analysis included 27 countries. Unstandardized coefficients are shown, and standard errors are given in parentheses.
†$p < .10$. **$p < .01$.

advantage in immediate word recall across the 27 countries ($r = -.800$). As expected, we found that across countries, less traditional gender-role attitudes were associated with better female cognitive performance in later life (i.e., immediate recall). This strong association was also found for the delayed recall and the fluency measure (see Fig. S1 in the Supplemental Material).

Table 2 shows that controlling for differences between world regions (Africa, America, Asia, and Europe) did not eliminate this association. Furthermore, including the log of the gross domestic product per capita in 2010 left the association virtually unchanged. This suggests that gender differences in cognitive functioning are not associated with the level of economic development per se but rather more specifically with the differences in gender-role attitudes that in turn may be associated with economic development. These results were replicated when we considered delayed recall and verbal fluency (see Table S7 in the Supplemental Material).

A challenge to the causal interpretation of our results is that there may be unobserved heterogeneity among countries that may be correlated with both gender-role attitudes and gender differences in cognitive performance leading to a spurious correlation. Thus, we ran a cross-country, cross-cohort analysis (Equation 1). Results consolidated the support for our hypothesis: Within countries, changes in the degree of traditionalism in gender-role attitudes across cohorts were associated with changes in the relative female advantage in cognitive functioning ($\beta = -0.181$, $SE = 0.073$, $p < .05$, $N = 81$, 27 countries × 3 cohorts). These results were replicated when we considered delayed recall and verbal fluency (see Table S8 in the Supplemental Material).

Checking for reverse causality: Protestantism

Table 3 shows the results when using Protestantism as an instrumental variable for gender-role attitudes. Results confirmed the hypothesis that Protestant countries were less likely to have traditional gender-role attitudes ($\beta = -0.291$, $SE = 0.050$, $p < .01$). The F test of the excluded instrument confirmed that our instrument was highly relevant, $F(1, 22) = 34.23$. The reduced-form estimates show that women in Protestant countries have higher relative cognitive test scores than women in non-Protestant countries. Further, results from the instrumental-variable estimator confirmed that the relative female advantage in cognitive functioning was lower in countries with traditional gender-role attitudes, compared with countries with nontraditional gender-role attitudes ($\beta = -0.306$, $SE = 0.079$, $p < .01$; endogeneity tests did not reject the hypothesis that gender-role attitudes are exogenous, $p = .189$). This result was replicated when we used delayed recall and fluency measures as indicators of cognitive performance (see Table S9 in the Supplemental Material).

Table 3. Results of the Regression Analyses Predicting Relative Female Advantage in Immediate Word Recall Using Protestantism as an Instrumental Variable

Predictor	First stage: predicting traditional gender-role attitudes	Second stage: predicting relative female advantage in immediate word recall	
		Reduced model	Instrumental-variable model
Traditional gender-role attitudes			−0.306**
			(0.079)
Percentage of Protestants	−0.291**	0.089**	
	(0.050)	(0.023)	
Region: America	−0.035	0.024	0.013
	(0.048)	(0.022)	(0.022)
Region: Asia	0.111*	−0.052**	−0.018
	(0.041)	(0.019)	(0.023)
Region: Africa	0.304**	−0.126**	−0.033
	(0.051)	(0.023)	(0.026)
Intercept	0.359**	0.015†	0.125**
	(0.019)	(0.009)	(0.024)

Note: The analysis included 27 observations. Unstandardized coefficients are shown, and standard errors are given in parentheses. The *p* value for the Wu-Hausman endogeneity test of the instrumental-variable model was .189. Small-sample statistics adjusting for degrees of freedom are shown.
†$p < .10$. *$p < .05$. **$p < .01$.

Potential mediators: education and work

Finally, we investigated the hypothesis that education and labor-force participation during the life course mediate the effect of gender-role attitudes on gender differences in cognition. We conducted an individual-level analysis using cross-country variation in gender-role attitudes. Results are presented in Table 4. Those results were replicated when we used delayed recall and fluency measures (see Tables S10 and S11 in the Supplemental Material). The parameter of interest is the coefficient related to the interaction term between the dummy code for being a woman and the country-level measure of traditional gender-role attitudes (gender difference here corresponds to the difference in the normalized test score; the country-level analysis was conducted using the relative gender difference in test scores). Model 1 was the individual-level analysis that, as expected, found that the female advantage in immediate recall decreases in countries with more traditional (vs. less traditional) gender-role attitudes. Controlling for a quadratic function of age in Model 2 did not change the results. As expected, Model 3 showed that including education as a mediator explained almost 20% of the association between gender-role attitudes and gender difference in immediate word recall. Finally, education and labor-force participation over the life course contribute about 30% to understanding the association between gender-role attitudes and gender differences in immediate-recall test score. Note, however, that the association remained highly significant, which indicates a partial mediation. The significant mediating role of education and labor-force participation was also confirmed across cohorts within countries (see Table S6 in the Supplemental Material). In sum, those results supported our hypothesis that one way in which gender-related attitudes impact cognitive functioning is by influencing women's likelihood (i.e., opportunity) of participating in cognitively stimulating activities during their life course.

Discussion

The present study helped to unravel some of the contradictory results found in earlier work on gender differences in cognition in adulthood and old age that showed that women outperformed men on memory tasks in some countries but not in others (e.g., Lei et al., 2014; Read et al., 2006). Thanks to its large and broad country-comparative database, this study is the first to demonstrate how pervasive the sociocultural effects on gender variation in cognition among older individuals can be. This is not to say that there are no biological influences on gender difference in cognitive functioning in later life. However, the evidence on hormonal

Table 4. Results of the Regression Analysis Predicting Immediate Word Recall, Including the Interaction Term for Gender and Gender-Role Attitudes

	Relative female advantage in immediate word recall			
Predictor	Model 1	Model 2	Model 3	Model 4
Female	0.336**	0.341**	0.350**	0.341**
	(0.027)	(0.026)	(0.032)	(0.028)
Traditional Gender-Role Attitudes × Female	−0.785**	−0.781**	−0.635**	−0.549**
	(0.119)	(0.118)	(0.127)	(0.107)
Age		0.066**	0.070**	0.068**
		(0.009)	(0.008)	(0.008)
Age^2		−0.001**	−0.001**	−0.001**
		(0.000)	(0.000)	(0.000)
Primary education			0.176*	0.174*
			(0.063)	(0.063)
Secondary education			0.525**	0.517**
			(0.071)	(0.070)
Higher education			0.800**	0.790**
			(0.070)	(0.068)
Education missing			0.258*	0.288**
			(0.107)	(0.085)
Never worked				−0.157**
				(0.027)
Work status missing				−0.398*
				(0.147)
Intercept	−0.157**	−1.135**	−1.886**	−1.801**
	(0.012)	(0.286)	(0.286)	(0.291)
R^2	.005	.122	.176	.178

Note: In these models, male was the reference category for the gender variable, working or has worked was the reference category for the working-status variables, and none was the reference category for the education variables. Dummy codes for country and region were entered in all four models. Results are based on 226,661 observations. Unstandardized coefficients are shown, and standard errors (clustered at the country level) are given in parentheses. The dependent variable was the test score in immediate word recall (normalized at the country level). Equation 2 was used to estimate these models.
*$p < .05$. **$p < .01$.

influences on cognitive gender differences throughout the life course is not as convincing as once thought (cf. Miller & Halpern, 2014).

This study showed that culturally transmitted gender-role attitudes help to explain the impact of education and labor-force participation on later-life cognition in women in different countries. The results are consistent with the interpretation that less traditional gender-role attitudes increase the likelihood of women participating in higher-level education and subsequent participation in the labor force. And education and labor-force participation have been found to serve as mental stimulation that increases the level of cognitive functioning (e.g., Bonsang et al., 2012; Gerstorf, Ram, Hoppmann, Willis, & Schaie, 2011).

Building on studies that have investigated the effect of sociostructural and cultural country differences on individual outcomes (e.g., Reitz, Shrout, Weiss, & Staudinger, 2016), we were also able to show that—in line with gender-identity theorizing (Bussey & Bandura, 1999; Miller & Halpern, 2014; Wood & Eagly, 2002)—cultural influences such as gender-role attitudes have predictive power over and above sociostructural characteristics such as participation in the educational system and the labor market. This result is in line with findings on the detrimental relationship between negative old-age stereotypes on cognitive functioning in later life (e.g., Levy, 2009). Negative old-age stereotypes similarly as traditional gender-role attitudes not only seem to affect the availability of mental stimulation (through education and labor-force participation) but also the self-confidence and self-esteem to seek out such opportunities. We hope that in the future, more data will become available across a large range of countries in order to empirically test this interpretation.

It is a key finding of our study that social and cultural determinants (in this case, attitudes toward the role of women in society) affect old-age outcomes (in this case,

cognition). Other important determinants of cognition, such as education, have also been found to lead to better cognitive performance at older ages (Schneeweis et al., 2014). However, over the past century, the gap in average educational attainment between nations has been narrowing (Lee & Lee, 2016), which suggests that the potential for education to affect cognitive performance is decreasing. Indeed, the role of cultural determinants, such as values and belief structures, may exercise a greater influence on cognitive outcomes because most nations experience less exposure to other predictors of cognitive outcomes that could potentially affect old-age outcomes (GBD 2015 DALYs and HALE Collaborators, 2016), and further, most nations become more similar in terms of socioeconomic development (e.g., overall inequality levels and reductions in population shares in absolute poverty or illiteracy levels; Lee & Lee, 2016). In a number of nations, however, gender-related attitudes have not converged with economic and educational development (Inglehart & Norris, 2003; Yu & Lee, 2013).

We acknowledge some limitations of our study. First, our measures of cognitive performance are limited to episodic memory and executive functioning. Thus, we cannot know whether our findings generalize to other indicators of cognitive performance. Word-recall tests, however, do involve a broad network of brain regions and imply a variety of cognitive functions, such as language, attention, and executive functioning (Tulving, 2002). Second, this study was observational in nature and not experimental. But the fact that our findings are robust to different estimation strategies based on cross-country comparisons, on cohort differences within countries, and on instrumental variables is reassuring. Also, using an instrumental-variable approach allowed us to reduce the risk of reverse causality. We demonstrated that it is unlikely that in countries with traditional gender-role attitudes, women were less cognitively able to start with.

Third, given the cross-sectional nature of our data, we cannot rule out alternative interpretations of our results, such as that gender differences in cognitive performance already appeared earlier in life or that they are due to differential cognitive aging. Research has shown that cognitive gender differences early in life seem to be very sensitive to contextual influences (such as cultural values and schooling; Miller & Halpern, 2014). Some studies identified gender differences in episodic memory among children in the United States (e.g., Kramer, Delis, Kaplan, O'Donnell, & Prifitera, 1997). But we are not aware of any cross-country comparison of gender differences in episodic memory in childhood. Also, we would argue that even though those gender differences may exist already in childhood, because of the adaptability of the brain, they need to be maintained throughout the adult life span. Our study found that opportunity structures, such as those provided by educational setting and labor-force participation, seem to be doing that. In terms, of differential cognitive aging, it is known that gender differences in late-life cognition at least have been demonstrated to persist longitudinally rather than showing gender-specific slopes (de Frias, Nilsson, & Herlitz, 2006; Ferreira, Ferreira Santos-Galduróz, Ferri, & Fernandes Galduróz, 2014; Gerstorf et al., 2011). Of course, we would ideally like to have available longitudinal data covering the complete age range, which would be comparable across countries. Fourth, we would like to point out that it would be useful for future studies to include life-course information about labor-force participation and lifelong learning efforts, which we did not have available across all the countries included in our study.

Finally, our study found that less traditional gender-role attitudes are associated with higher levels of cognitive functioning of women relative to men in later life. A follow-up question is whether this association is due to better performance of women or due to worse cognitive performance of men. Answering such a question requires a comparison of the levels of cognitive test scores for men and women across countries. However, a cross-country comparison of the level of cognitive test scores (contrary to comparing gender differences) is compromised by variations in cognitive test scores due to cross-country differences in language, survey design, and environmental factors that are common to men and women rather than to true cognitive differences. By using the gender difference in cognitive performance, these imprecisions are neutralized. Note, however, that our data suggest that more gender-egalitarian attitudes were not associated with worse cognitive test scores of men across countries. In fact, we found that men had higher cognitive test scores in more egalitarian countries, but women profited even more.

This study adds to the literature on the importance of culture and social-cognitive factors for determining life-course outcomes and shows that psychological theorizing (i.e., gender identity formation and life-span psychology) is able to help in unraveling such influences. It highlights that attitudes prevalent in a given society may contribute to its productivity levels. Given the current trend toward more equal gender-role attitudes among younger cohorts in many countries, we may expect further improvements in the relative position of women in terms of cognitive functioning at older age in these nations.

Action Editor

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Author Contributions

E. Bonsang conceived and designed the study, and also analyzed the data. All of the authors interpreted the results, drafted parts of the manuscript, provided critical revisions, and approved the final version of the manuscript for submission.

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The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

Supplemental Material

Additional supporting information can be found at http://journals.sagepub.com/doi/suppl/10.1177/0956797617708634

Notes

1. Israel was not included in the analysis because the measure of gender-role attitudes (described in the Measures section) is not available for this country.
2. There are observations with missing information for the cognitive test scores (around 5% of the full sample). In order to check whether this might induce a selection bias, we tested the association between gender-role attitudes and the gender differences in the proportion of missing observations and found no significant association, which suggests that our analysis was unlikely to suffer from sample-selection bias because of missing test scores.
3. Table S4 in the Supplemental Material presents the average test scores for men and woman, the relative female advantage in test scores, and the degree of traditionalism in gender-role attitudes by country.
4. We weighted the data so that each country had the same weight in the analysis. The results were thus not driven by the sample-size differences across countries. We also estimated the model without using weights, and the results remained consistent with those presented in this article.

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