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Numeracy and Financial Wellbeing During the COVID-19 Pandemic

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Numeracy and Financial Wellbeing During the COVID-19 Pandemic

Abstract

This paper examines the role of numeracy in smoothing financial difficulties during the COVID-19 pandemic. The results show that numeracy was associated with a 30% reduction in late or non-payment of bills and a 20% reduction in the odds of feeling financially squeezed. The effect of numeracy on financial wellbeing was remarkably consistent across levels of education, ethnicity, and gender, suggesting that improving numeracy levels in the population may be an effective strategy to increase financial capability across the board. However, while numerate individuals were less likely to experience financial difficulty, high numeracy did not predict narrower gaps between Whites and ethnic minorities during the COVID-19 pandemic. Governments must take seriously the need to address the constraints and institutional barriers that keep individuals from achieving financial wellbeing.

Keywords

numeracy, financial wellbeing, financial capability, multiple imputation, COVID-19

Cover Page Footnote

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Introduction

In this article, I explore the extent to which numeracy, defined as the skills and knowledge required to use numbers in daily life, facilitates positive financial behaviors and decision-making (Gal and Tout 2014; National Numeracy 2017). In particular, I examine whether numerate individuals were better equipped to avoid financial difficulties during the early months of the COVID-19 pandemic. The global crisis has exposed deep economic fissures within many modern, highly industrialized societies, pressing families' financial situations to the breaking point. Notwithstanding government-backed income supports and payment holidays, one in four families in the UK are living on reduced incomes, whether due to job loss, reduced hours, or gaps in furlough support (Adams-Prassl et al. 2020; Handscomb and Judge 2020; Mayhew and Anand 2020). Business owners and workers alike face the struggle to rebuild; for many, it will depend on their ability to make ends meet until economic conditions improve (Nitani et al. 2020). Individuals who can draw on resources within themselves to manage economic shortfalls will be better equipped to mitigate the long-term damages that a prolonged economic recovery could inflict (Banks and Oldfield 2007; Wiersma et al. 2020).

Numeracy is complementary to but distinct from financial literacy (Moreira Costa et al. 2020), as the skills and knowledge required to choose a loan or invest one's savings may be less relevant than are basic skills with numbers when it comes to paying bills on time and keeping spending in line with income. However, both facilitate the development of financial capability through the acquisition of knowledge and skills that help people make sound financial decisions (Almenberg and Dreber 2015; Wiersma et al. 2020). While numeracy is closely linked to general educational attainment and tends to correlate with increased earnings and wealth (Ritchie and Bates 2013; Cole et al. 2014), even high earners can struggle with debt and other financial challenges that result from difficulties managing money (Lusardi and Mitchell 2014; Estrada-Mejia et al. 2016; Lusardi 2019). At the same time, low earnings are not necessarily an impediment to saving or avoiding debt for people who know how to manage their money well (De Marco et al. 2015; Stavins 2021).

The question of which factors can help individuals negotiate economic downturns is important because people are fairly constrained in their ability to improve their financial situation, short of changing jobs or reducing spending. Improving one's numeracy skills lies within one's control and can yield long-term rewards: Estrada-Mejia and colleagues (2016) estimate the wealth returns for improved numeracy to be similar in size to the returns of completing a university degree.

The sudden shock of lockdown provides a unique opportunity to examine whether numeracy mitigates the effects of sudden income reductions on risk of late bill payments and associated strains. This study also addresses an important research gap resulting from the dearth of research on numeracy and ethnicity in the UK. Although many studies link numeracy to financial wellbeing, few existing studies include ethnicity as a covariate in analyses (Carpentieri et al. 2009). This contribution is particularly important given that the economic burdens incurred due to the pandemic and ensuing lockdowns have fallen disproportionately on ethnic minorities (Blundell et al. 2020; Brewer et al. 2020; Platt and Warwick 2020), who are more likely to be key workers at the frontline of the pandemic, and/or to hold public-facing, service-sector positions that offer low pay and limited job security (Adams-Prassl et al. 2020; Crossley et al. 2021; Davenport et al. 2020).

I extend previous research by using longitudinal data from a nationally representative household sample to assess the long-range effects of numeracy on financial behavior. This study is rigorous in its use of survey-weighted multiple imputation to limit bias due to differential rates of non-response among vulnerable subgroups. The key predictor, numeracy, draws on the types of skills that individuals use daily when managing their finances. These skills are arguably more relevant to day-to-day money management than are the skills and knowledge covered in traditional financial literacy scales (Stolper and Walter 2017). Finally, the two outcomes capture objective as well as subjective financial difficulties.

I find that highly numerate individuals were less likely to experience financial distress during the first six months of the pandemic period than less numerate individuals were. When translated into predicted probabilities, the results show that numeracy reduces the risk of late or missed bill payments by approximately 30%. Stratified analyses by gender, ethnicity, and education level affirm the core findings from the main models and demonstrate that the protective effect of numeracy is consistent across gender, ethnicity, and levels of education.

Nonetheless, sharp differences by ethnicity persisted, even after accounting for sociodemographic factors. Highly numerate minorities remained at higher risk of bill payment problems than did less numerate Whites. These ethnic disparities reflect the structural disadvantages that many ethnic minorities in the UK experience, which regulators will need to address if the UK is to be successful in helping its citizens achieve financial wellbeing.

Literature Review

This research draws on economic theories of consumption and financial decision-making (Carroll 1997; Lusardi 1998; Deaton 2009). In seeking to maintain a permanent income over the life-course, individuals engage in future-oriented spending and saving behaviors. Deferring consumption to ensure that one can pay

bills on time and avoid debt yields benefits that accrue over time, as people can smooth consumption during periods of economic shortfalls without needing to make drastic adjustments to their standard of living (Morduch and Schneider 2017). Financially fragile households lack sufficient savings or access to credit to navigate income shocks, such as job loss or unexpected expenses (Lusardi et al. 2011). Individuals who lack this asset cushion remain vulnerable to hard times and to the spillover effects of financial strain on their broader quality of life (Beverly 2001; Iceland and Bauman 2007; Codagnone et al. 2020). Yet financial squeezes affect even those who should conceivably have sufficient income to avoid financial difficulties, so financial strain is not merely the consequence of insufficient income (Iceland et al. 2021).

The COVID pandemic followed two decades of financial upheaval that began with the tech bubble and housing boom. By 2009, only 50% of Americans surveyed felt that they could pull together $2,000 in a short time, a finding replicated in the UK and generally supported by results in other European countries (Lusardi et al. 2011). The UK economy emerged slowly from the Great Recession, only exiting it fully by 2013. Meanwhile, the government continued to pursue the austerity policies it had first introduced in 2010, most notably a widescale reform of social welfare benefits (Hirsch 2020). More than a decade after the financial crisis, the percentage of UK households that could not meet a sudden expense remained stubbornly high at 30%, above the EU average. Residents living in countries beset by more recent financial crises demonstrate markedly high rates of vulnerability (Demertzis et al. 2020).

When the UK went into lockdown in March 2020, many families, particularly those reliant on self-employment, risked a total loss of income. The UK Job Retention Scheme stabilized the economy by providing up to 80% of furloughed workers' salary, functioning effectively as a kind of life support for firms within some job sectors (Cominetti et al. 2021; Tomlinson 2021). Although this entailed some lost income, for most families the tradeoff between job protection and income was beneficial, particularly for those who ordinarily incurred high transit and related work expenses (Brewer and Gardiner 2020). However others continue to lack any savings buffer: in 2018, roughly one-quarter of UK households would have lacked the means to make ends meet were their incomes to have declined by 25% over a three-month period (Office for National Statistics 2020).

The recovery period has been marked by the removal of furlough money and the paring back of welfare supports in the form of Universal Credit. Brexit continues to pose serious financial and logistical challenges that weaken the UK's economic position (McCann et al. 2021). Against this backdrop of financial uncertainty, interventions that equip people with the skills needed to save can play a critical role in buffering families during periods of economic difficulty.

Numeracy and Financial Decision-making

Numeracy is a skill distinct from general educational attainment that helps shape one's level of financial capability and wellbeing (Almenberg and Dreber 2015; Govindarajan 2016; Eberhardt et al. 2019; Sunderaraman et al. 2020; Wiersma et al. 2020). It does not require advanced mathematical understanding (Gal and Tout 2014), and in fact encompasses the sorts of ordinary arithmetical computations taught in elementary and secondary schools (Money Advice Service 2017). Numeracy is arguably more important on a day-to-day basis than are the topics and financial concepts covered in financial literacy programs, because it enhances individuals' abilities to make the countless small daily financial decisions that help determine their long-term financial trajectories (LeBaron et al. 2019; LeBaron et al. 2020; Santana et al. 2020).

Numeracy confers multiple advantages when it comes to financial decision-making (Garcia-Retamero et al. 2019; Roozenbeek et al. 2020). One major benefit is the ability to understand interest and savings rates (Banks and Oldfield 2007; Stango and Zinman 2009; Agarwal and Mazumder 2013; Gerardi et al. 2013; Klapper and Lusardi 2020). Agarwal and Mazumder (2013) examined the associations between numerical ability, as measured using standardized test scores, and credit use. Credit use errors were predominantly made by individuals with poor mathematical comprehension, and it took them longer to discover optimal credit use strategies.

Numerate individuals differ not merely in their ability to perform mathematical calculations, but also in their ability to extract meaningful information from numerical data. They spend more time thinking through numerical problems than others do, and they are more comfortable drawing on numerical information when doing so (Graffeo et al. 2015; Ashby 2017). Highly numerate individuals are less likely to fall back on heuristic devices and are less vulnerable to the power of framing or emotion (Peters et al. 2006; Eberhardt et al. 2019; Moreira Costa et al. 2020). If numeracy fosters behavioral habits that reduce individuals' tendency to act impulsively (Eberhardt et al. 2019), the net effect is to limit the extent to which people find themselves having overspent (Gerardi et al. 2013; Parise and Peijnenburg 2019; Frigerio et al. 2020). Avoiding costly mistakes is one means by which families can strengthen their long-term financial situation and mitigate the damage incurred from chronic stress and conflict over finances (Ong et al. 2019; Sabri and Aw 2020).

Numeracy can further solidify people's finances as confidence with numbers spills over into confidence in their ability to engage with financial matters on a regular basis (Lusardi 2012). High numeracy is positively associated with debt repayment, stock market participation, asset ownership, and wealth (Banks and Oldfield 2007; Banks et al. 2010; Almenberg and Dreber 2015; Von Gaudecker 2015; Estrada-Mejia et al. 2016; Eberhardt et al. 2019; Lusardi 2019). For those

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who avoid dealing with their finances, due to an underlying discomfort with math that leaves them anxious around numbers (Cwynar et al. 2019), this avoidance can have lifelong consequences. Low numeracy increases the amount of time people spend in delinquency on mortgage payments and their risk of foreclosure (Gerardi et al. 2013). It also reduces the extent to which people are capable of raising funds in an emergency (Wiersma et al. 2020).

Numeracy and Financial Literacy

Numeracy is intrinsically linked to financial literacy, insofar as two of the "big three" questions used to measure financial literacy relate to interest calculations that necessitate a baseline understanding of both financial concepts and multiplication (Lusardi and Mitchell 2011b). This link has led some financial capability models to treat numeracy as a precursor to the acquisition of financial literacy (Lusardi 2012; Skagerlund et al. 2018). However, financial education programs rarely address skills deficits with numbers, instead favoring more generalist coverage of financial topics that may range from budgeting to investment planning (Fox et al. 2005; Fernandes et al. 2014; Alsemgeest 2015).

The drawback to this generalist approach is that it presumes that individuals are capable of dealing with numbers and the mathematical operations that undergird credit and investment decisions (Von Gaudecker 2015). It is fairly straightforward for someone to understand how compound interest differs from simple interest, *if* they know how to perform the underlying calculations correctly (Foltice and Langer 2017, 2018; Skagerlund et al. 2018). Yet low numeracy is pervasive among those with even the highest levels of education (Lipkus et al. 2001; Banks and Oldfield 2007; Kuczera et al. 2016). Calculations involving percentages and division are particularly challenging for many people (Chen and Rao 2007; Lusardi 2012; French and McKillop 2016), and this has ramifications for their ability to make price comparisons, calculate interest rates, and understand debt repayment terms (Amar et al. 2011; Graffeo et al. 2015).

Difficulty with numbers places individuals at much greater risk of falling into costly debt traps and missing out on saving opportunities (Soll et al. 2013; Kim et al. 2019). They are also much less likely to engage with mainstream financial products and services, which perpetuates the cycle of low saving and lost wealth (Von Gaudecker 2015). For individuals who lack that foundation of confidence and skills with numbers, studies have shown that gains in general financial knowledge do not translate into changes in behavior (Carpena et al. 2011; Cole et al. 2016; Govindarajan 2016). However, increasing the time spent on mathematics during secondary education appears to have strong spillover effects on a wide range of short- and long-term financial outcomes (Cole et al. 2016; Skagerlund et al. 2018).

Study Purpose and Hypotheses

This analysis is organized around two main questions: First, what is the effect of numeracy on financial behavior and wellbeing? Second, is the effect of numeracy constant across demographic characteristics? The COVID-19 pandemic resulted in economic shocks that fell differentially on households, resulting in a dynamic in which some individuals experienced sharp, sudden losses of income, while others felt no economic losses, and some even benefited from the reduction in transportation and job-related expenses. For those who lost work or income during the pandemic, one might expect that bill payment difficulties would increase, due to the narrow time-period to adjust expenses and the limited opportunities to replace lost income. I hypothesize that highly numerate individuals will experience fewer money management problems that result in late or missed household bill payments.

I next explore whether demographic characteristics alter the relationship between numeracy and financial wellbeing. Research and policy work has focused extensively on gender differences in financial capability and wellbeing (Almenberg and Dreber 2015; Bucher-Koenen et al. 2017; Robson and Peetz 2020), due to persistent gender gaps in earnings, numeracy, financial knowledge, and confidence about financial matters. Men tend to perform better on numeracy tests than women and report greater confidence in their ability (Lusardi 2019; Wiersma et al. 2020). As numerical ability and confidence correlate with financial knowledge, gender differences in asset ownership, investment, and wealth may reflect gender differences in numeracy (Almenberg and Dreber 2015; Grohmann 2018; Bottazzi and Lusardi 2020).

Yet there remains limited consideration of the role of ethnicity in shaping financial capability (Willows 2019; Money and Pensions Service 2020; Willows 2020), despite evidence to suggest that ethnic disparities are as large, or larger, than the gender disparities that continue to attract policy focus (Lusardi and Mitchell 2007; Ginde et al. 2008; Lusardi and Mitchell 2011a; de Bassa Scheresberg 2013; Kim et al. 2019; Angrisani et al. 2020; Clark et al. 2021). When Willows (2019, 2020) measured levels of financial knowledge in a diverse sample of South African professionals, minorities demonstrated less confidence in their level of financial knowledge than did Whites. On a more positive note, Willows (2020) found that ethnic differences in financial literacy did not manifest as differences in financial behaviors or retirement planning after accounting for financial literacy and attitude.

The aim of this article is not to examine whether there are ethnic variations in numeracy levels, but instead to consider ethnicity as an important demographic characteristic, equal to gender, in achieving financial wellbeing (Harvey 2019). This aim will cast light on the extent to which numeracy relates to financial wellbeing in the larger population, and provide an opening for interventions to help families negotiate financial shocks and develop long-term savings (Lusardi 2019). In addition to the specific focus on gender and ethnicity, I also examine whether the

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effect of numeracy remains consistent at differing levels of education, in part to address concerns that numeracy merely reflects one's educational attainment and offers limited promise to anyone with less than a given level of education.

Data, Variables, and Methods

Data

This analysis combines data from the main and COVID-19 surveys of the United Kingdom Household Longitudinal Study (UKHLS, or Understanding Society) (University of Essex, Institute for Social and Economic Research 2019, 2021). Understanding Society is a large-scale longitudinal study that follows households over time to obtain nationally representative estimates of the UK. Members complete questionnaires annually that were initially delivered as face-to-face interviews in the home, but increasingly have been implemented via the telephone or internet. Respondents receive vouchers for each questionnaire they complete, and there are rewards available for maintaining contact with the study between surveys, such as when participants move or form new households.

In the wake of the COVID-19 pandemic, the UKHLS revised its study design to enable research on the effects of the pandemic on UK households. Individuals living in participating households during recent waves of the study (Waves 7–9) were invited to complete web-based surveys on a semi-monthly basis, beginning in April 2020. The sample consists of respondents who answered questions on numerical ability during Wave 3 of the Main Study (2011/12) and remained involved in the study by Wave 9 ($N = 13{,}898$).

Outcome Variables

Two items capture individuals' experience of objective and subjective financial distress. Each is derived from questions posed in Waves 1, 2, and 4 of the COVID-19 Study (April, May, and July 2020). *Late payment* is defined as having fallen behind on any household bills during the early months of lockdown. Individuals who indicated at any of the three survey periods that they were not up to date on either bills or housing payments are coded as 1, whereas those who reported no problems at any wave are coded as 0.

The second item is a subjective measure of *financial difficulty* that codes as 1 any respondents who reported that they were either struggling financially or just getting by (0 = Comfortable or doing alright). As with the late payment item, those who expressed at any of the three waves that they were just getting by or having a difficult time were coded as 1.

Predictor Variables

Numeracy is an ordinal variable based on people's responses to a set of numerical ability items included in the Wave 3 (2011/12) survey (Gray et al. 2011; McFall 2013). Household residents aged 16 years and older were asked up to five questions that assessed skills ranging from addition and subtraction to the calculation of compound interest, reflecting the types of mathematical calculations common to ordinary life. Respondents were given as much time as needed and could use notepaper to calculate their answers. Translators were available for respondents who spoke languages other than English. Respondents who refused to answer a particular item were not asked further questions in the series (McFall 2013), and they have been excluded from analyses.

Questions were presented to respondents in order of increasing difficulty. Those who answered the first three items correctly were then asked up to two more questions, depending on whether they answered the fourth question correctly. Although this limits the usefulness of the raw score as a measure of numerical ability, it is feasible to include numeracy as a categorical item in regression analyses (0–3, 4, or 5 correct answers). Five correct responses as the cutoff for high numeracy corresponds to work by National Numeracy on the "Essentials of Numeracy" and is roughly equivalent to Level 3/4 of the OECD adult skills survey (Kuczera et al. 2016; National Numeracy 2017). It is also equivalent to the best performing group used in Banks and Oldfield (2007). Using this threshold, 29% of the sample met the criteria to be considered highly numerate, and an additional 22% answered four questions correctly, but were not able to answer the final question involving compound interest.

Control variables from Wave 9 include age, gender, ethnicity, education, employment status, general health, disability, relationship status, per-capita household income, and housing type. Information about benefit receipt and household income changes were obtained from the COVID-19 surveys to reflect individuals' financial situations during the lockdown period.

Analyses

The key predictor, numeracy, had complete data, because individuals needed to have answered at least some of the numeracy items in Wave 3 to be considered eligible for the analysis. However, other items were subject to missing information. When feasible, I used individuals' responses at other waves to capture time-stable demographic characteristics. I then used multiple imputation by chained equations (MICE), a sequential regression-based imputation procedure that can be adapted for use with different types of variables, including sampling weights and hierarchically nested data (Enders et al. 2016).

The appendix provides details on the imputation method. When compared to the original data, the imputation process resulted in no major changes to variable

distributions, other than to increase slightly the percentages who paid bills late or felt financially squeezed. Certain demographic characteristics that were associated with missing data, such as ethnicity, age, and education level, also predisposed people to experiencing financial pressure, so this may explain the slight differences in the financial outcomes between the original and imputed data.

I next implemented survey-weighted logistic regression to model the associations between the predictors and binary outcomes (Lumley 2004). In line with Rubin's rules, the multiple logistic regression models were conducted within the individual imputed datasets. The estimates obtained from these models were then pooled to generate a single set of results for each analysis (Rubin 2004). The imputed results are similar to those found in models using complete cases (shown in appendix Tables A.2 and A.3), so the emphasis in the results section is on findings from the imputed data. Supplementary models that included quadratic and cubic terms for age and income are available by request from the author. All analyses were conducted in R v4.0 (R Core Team 2020).

Results

Table 1 presents weighted descriptive statistics for the original and imputed data. The sample was predominantly female (53%), White (93%), employed (58%), and married or living with a partner (64%). Four in ten had completed post-secondary education, and the majority owned their own home. Most households avoided serious financial difficulties during the early months of lockdown, as fewer than one in five respondents reported having fallen behind on bills. Twice as many felt that they were struggling financially or just getting by.

Figure 1 depicts the associations between numeracy and financial strain. Numerate individuals were significantly less likely than others were to experience either type of financial difficulty: They were half as likely to fall behind on bills as were people who scored low on numeracy, and they were much less likely to say that they were struggling financially. (Full bivariate statistics for the two outcome variables are shown in appendix Table A.1.)

Table 1
Weighted Descriptive Statistics

			Full sample	Complete cases	Imputed
			N = 13,898	N = 7,097	N = 13,898
		Missing	Mean (SD)	Mean (SD)	Mean (SD)
Numeracy score	0–2 correct	0	35.3	26.8	35.3
	3 correct		13.8	12.9	13.8
	4 correct		22.1	23.3	22.1
	5 correct		28.7	37.0	28.7
Age		0	52.7 (17.7)	52.2 (15.2)	52.7 (17.7)
Gender	Female	0	53.3	55.4	53.3
	Male		46.7	44.6	46.7
Ethnicity	White	2	93.3	94.9	93.3
	South Asian		3.0	1.9	3.0
	Black		1.3	0.9	1.3
	Mixed/Other		2.3	2.4	2.3
Nativity	UK born	193	91.8	93.0	91.8
	Not UK born		8.2	7.0	8.2
Relationship status	Married/cohabiting	8	64.2	71.8	64.2
	Single or not cohabiting		35.8	28.2	35.8
Education	Post-secondary	19	40.2	49.9	40.2
	Higher secondary		20.0	19.5	20.0
	Lower secondary		29.2	26.3	29.2
	No formal qualifications		10.6	4.3	10.6
Employment status	Employed	6	58.3	63.6	58.3
	Student or unemployed		4.2	2.9	4.2
	Not in the labor force		37.5	33.5	37.5
Health	Good to excellent	9	76.5	81.0	76.6
	Fair to poor		23.5	19.0	23.4
Disability	No	9	60.3	63.7	60.3
	Yes		39.7	36.3	39.7
Housing tenure	Own outright	263	37.9	40.6	37.8
	Own with mortgage		33.6	37.9	33.6
	Rented accommodation		28.5	21.5	28.6
Household income	Per capita, monthly	237	1,931 (1,549)	2,122 (1,889)	1,932 (1,551)
Benefit receipt	No benefits	5,466	88.6	88.7	86.9
	Any benefits		11.4	11.3	13.1
Late bill payment	No	6,567	85.7	86.0	81.0
	Yes		14.3	14.0	19.0
Financial situation	Doing alright	6,382	67.2	70.9	62.2
	Feeling squeezed		32.8	29.1	37.8

Notes: Percentages are presented for categorical items; robust standard errors for continuous measures appear in parentheses below their means. Population weights are applied to the observed and imputed data files to adjust for unequal selection and unit-response probabilities. Age and income are shown before transformations (e.g., log-transforming income, centering and scaling age and log(income)).
Source: Understanding Society (2019, 2021), Waves 1–9, 2011–2019, linked with COVID-19 Waves (2021).

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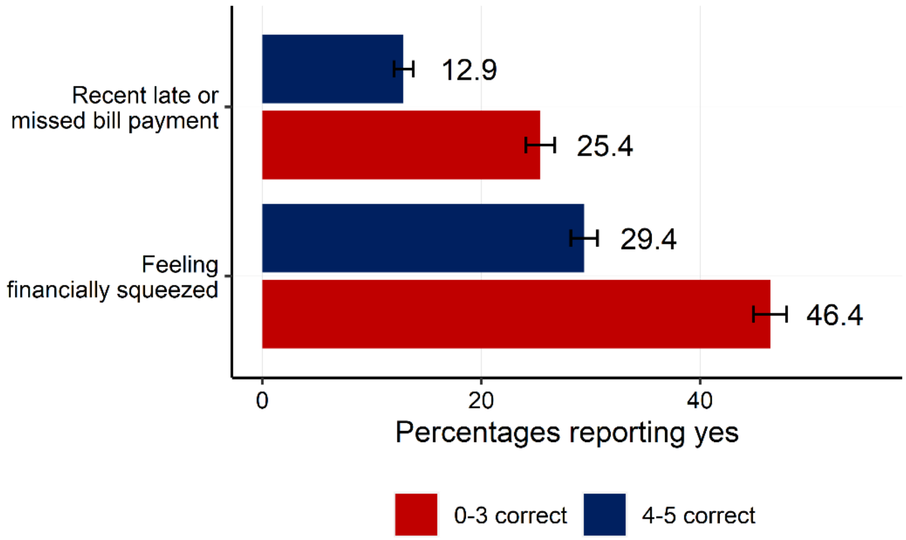

Figure 1. Association between numeracy and experience of financial strain during COVID-19. Source: Understanding Society (2019), Wave 3, 2011/12, linked with COVID-19 Waves (2021).

Table 2 presents logistic regression results for both outcomes. As model fit declined when interactions between numeracy and gender, ethnicity, and/or education were included in models, the results presented in this section examine the direct effects of numeracy on financial outcomes. High numeracy reduced individuals' odds of falling behind on housing or bill payments by approximately one-third, relative to those who scored low on numeracy (*OR* = 0.59 for those with 5 correct answers, *OR* = 0.72 for those with 4), even after accounting for elevated risk of arrears among people with lower secondary (*OR* = 1.69) or no formal qualifications (*OR* = 2.44). Blacks and South Asian respondents experienced much higher odds of bill payment problems than did Whites (with odds ratios of 3.45 for Blacks and 2.64 for South Asians). Other groups at heightened risk of late or non-payment included benefit recipients, the self-employed, renters, and individuals living with a disability or in fair to poor health. Older and more financially secure adults experienced fewer financial difficulties than did the young and financially vulnerable.

Results from the second model predicting subjective financial distress broadly support the results from the first model. Numerate individuals were less likely than others were to report dissatisfaction with their financial situation (*OR* = 0.73–0.77). Ethnic minorities continued to face heightened odds of financial strain, relative to Whites, but the odds ratios for Black and South Asian respondents (2.04) were smaller than they had been for the first model.

Table 2
Logistic Regression Results Predicting Financial Difficulties during the COVID-19 Pandemic

	Model I Late/missed bill payment				Model II Feeling financially squeezed			
	OR		*95% CI*		*OR*		*95% CI*	
Numeracy (ref. 0–3 correct)								
4 correct answers	0.72	**	0.57	0.91	0.77	**	0.66	0.91
5 correct answers	0.59	***	0.46	0.76	0.73	***	0.62	0.86
Age	0.80	***	0.73	0.87	0.92	*	0.86	0.99
Male (ref. Female)	1.34	**	1.11	1.62	1.15	*	1.00	1.33
Ethnicity (ref. White)								
South Asian	2.64	***	1.61	4.34	2.04	**	1.25	3.33
Black	3.45	**	1.71	6.95	2.04	*	1.07	3.89
Mixed/Other	1.10		0.62	1.93	1.56		0.93	2.62
Nativity (ref. Born in the UK)	1.41		0.99	2.02	1.35		0.98	1.87
Partner (ref. Married/cohabiting)								
Single or not cohabiting	1.14		0.91	1.41	1.38	***	1.17	1.62
Education (ref. Post-secondary)								
Higher secondary	1.23		0.95	1.58	1.34	**	1.12	1.61
Lower secondary	1.69	***	1.34	2.13	1.64	***	1.39	1.95
No formal qualifications	2.44	***	1.64	3.65	2.76	***	1.98	3.84
Employment status (ref. Employed)								
Student or unemployed	0.96		0.54	1.69	0.77		0.50	1.18
Not in the labor force	0.91		0.69	1.21	0.59	***	0.48	0.73
Housing tenure (ref. Own outright)								
Own with mortgage	0.88		0.68	1.13	1.96	***	1.64	2.35
Rented accommodation	2.03	***	1.52	2.70	3.50	***	2.83	4.34
Log(per capita household income)	0.85	*	0.75	0.97	0.55	***	0.47	0.64
Benefit receipt (ref. No)	2.01	***	1.55	2.61	2.63	***	2.06	3.35
Loss of household income (ref. No)	1.14		0.96	1.37	1.28	***	1.13	1.46
Health (ref. Good to excellent)								
Fair to poor	1.27	*	1.00	1.61	1.94	***	1.62	2.32
Disability (ref. No)	1.28	*	1.03	1.58	1.23	*	1.05	1.44
Country (ref. England)								
Wales	1.47	*	1.04	2.08	1.09		0.80	1.47
Scotland	1.12		0.80	1.57	0.95		0.75	1.21
Northern Ireland	1.06		0.65	1.73	1.07		0.71	1.62

Notes: Pooled results of 50 imputation datasets. Standard errors adjusted for complex survey design which involves clustering, stratification, and oversampling. Population weights adjust for unequal selection and unit-response probabilities.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Source: Understanding Society (2019, 2021), Waves 1–9, 2011–2019, linked with COVID-19 Waves (2021).

Older adults and those living in higher-income households reported higher levels of financial satisfaction than did younger and lower-income respondents. Conversely, the self-employed, people who qualified for benefits, and those living on reduced household incomes all faced increased odds of financial strain. When compared to people who owned their homes outright, both mortgage holders and renters faced increased odds of financial difficulty, albeit to a greater extent for renters (*OR* = 3.50) than for mortgage holders (*OR* = 1.96). Cohabiting individuals fared better than did those who were single or living without a partner.

Tables A.2 and A.3 present the results for Models 1 and 2 when using the original, unimputed data. Notwithstanding the slight differences between the observed and imputed data in the number of people estimated to have had financial difficulties, the substantive findings are the same.

Effects of Numeracy across Demographic Groups

The results thus far indicate that numeracy improved individuals' financial situations, over and above the effects of education, employment, and income. In this section, I assess the extent to which numeracy benefited people equally, across gender, ethnicity, and education categories. I conducted a series of stratified analyses, the results of which are presented in Figures 2–4 (with full output from each model shown in appendix Table A.4) (Kuha and Mills 2020).

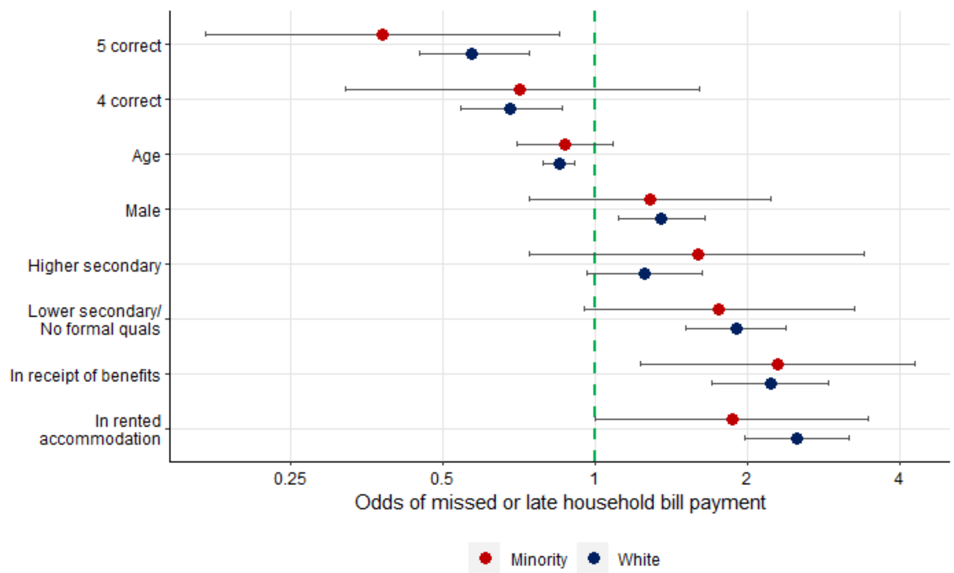

Figure 2. Odds ratios from models predicting bill payment problems by ethnicity. Note: Reference categories: Low numeracy, female, post-secondary education, no benefits, homeowner. Source: Understanding Society (2019, 2021), Waves 1–9, 2011–2019, linked with COVID-19 Waves (2021).

The odds ratios in Figure 2 compare results for Whites to those for ethnic minorities (who were grouped together due to low numbers within the original categories). Figure 3 presents model findings by education level, comparing individuals with a university degree or equivalent to those who had completed higher secondary education (e.g., A-levels) or less (e.g., GCSE or no formal qualifications, due to small numbers in these two categories). Figure 4 displays results by gender.

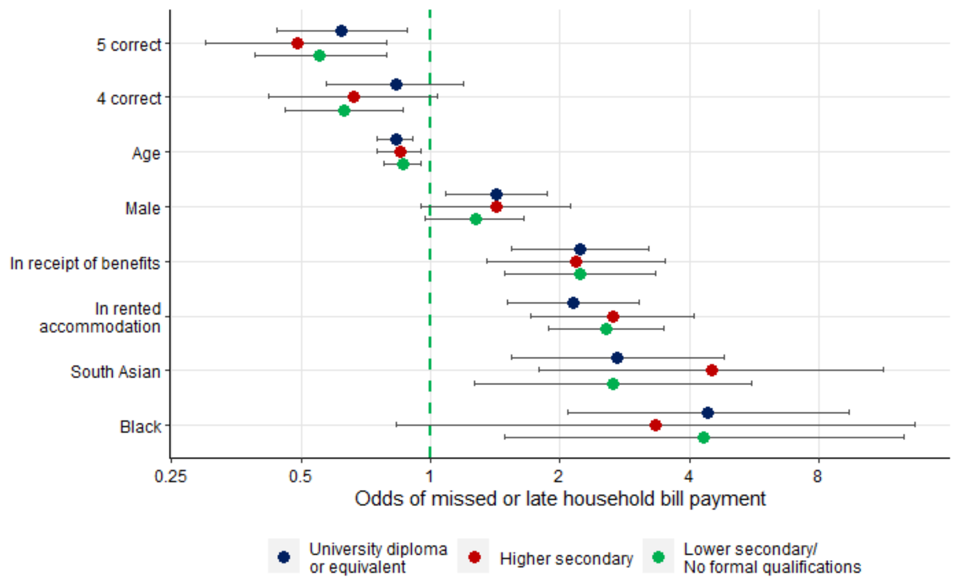

Figure 3. Odds ratios from models predicting bill payment problems by educational attainment. Note: Reference categories: Low numeracy, female, no benefits, homeowner, White. Source: Understanding Society (2019, 2021), Waves 1–9, 2011–2019, linked with COVID-19 Waves (2021).

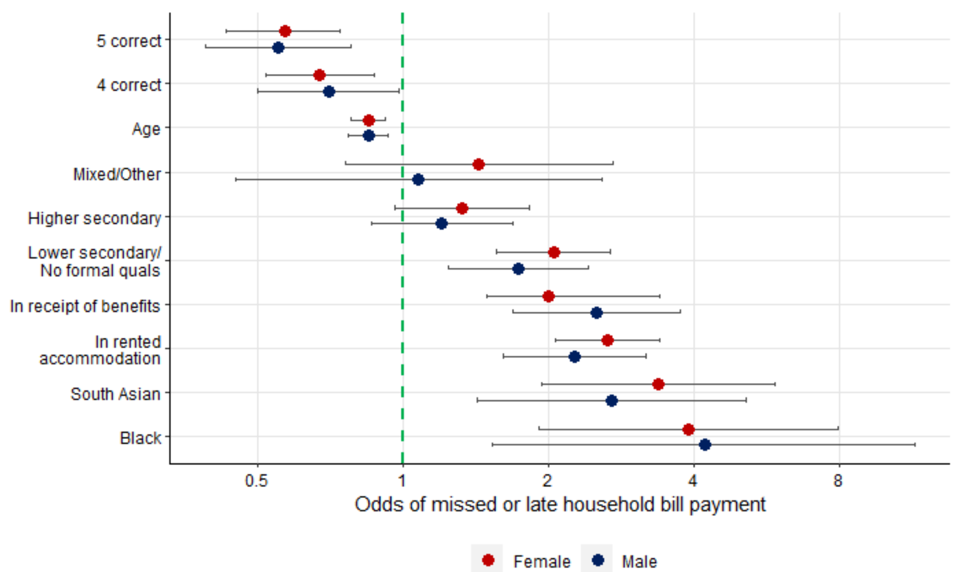

Figure 4. Odds ratios from models predicting bill payment problems by gender. Note: Reference categories: Low numeracy, post-secondary education, no benefits, homeowner, White. Source: Understanding Society (2019, 2021), Waves 1–9, 2011–2019, linked with COVID-19 Waves (2021).

The circles in each figure indicate the odds ratios for each predictor, and the lines extending from the circles reflect the 95% confidence intervals for the odds ratios. Confidence intervals that span the dashed vertical line (denoting an odds ratio of 1, equivalent to stating that a change in the predictor leads to no change in the odds of the outcome) identify predictors that are not significant for a particular group. Odds ratios located to the left of the dashed line indicate variables that reduce the odds of late bill payment, provided that the confidence intervals do not overlap the dashed line. Conversely, predictors with odds ratios greater than 1 are associated with increased odds of late bill payment.

The figures demonstrate that numeracy's protective effects were generally consistent across education levels and demographic groupings. For all groups, the odds ratio for answering all five questions correctly fell below 1, providing evidence of numeracy's ability to reduce individuals' risk of bill payment difficulties. The findings in Figure 3 demonstrate that numerate individuals with low levels of formal education experienced similar reductions in bill-payment difficulties as did individuals who had completed secondary or post-secondary education.

Despite evidence in prior research of gender differences in levels of numeracy and financial knowledge, there appear to be no gender differences in the underlying associations between numeracy and financial outcomes (Figure 4). The gender-stratified models yielded strikingly homogenous results, by comparison to the models stratified by education or ethnicity; however, that may have been due to differences in sample size for the ethnicity- and education-stratified models. Whites composed 93% of the overall sample, so even after combining all ethnic minorities into one group, the confidence intervals for ethnic minorities remain wide relative to those for Whites.

Predicted Probabilities of Bill Payment Problems

To put the results from Model 1 in context, I used the coefficients to calculate predicted probabilities of bill payment difficulties by numeracy and age (Figure 5), income (Figure 6), and ethnicity (Figure 7). Estimates were obtained using the coefficient estimates from Model 1 shown in Table 2, with continuous items set to their means and dummies set to the categories noted in the figure captions. Age and household income were each significantly associated with reduced risk of bill payment problems, but there was no indication of any interaction effect between either of these items and numeracy (results available upon request). Young adults were twice as likely to encounter financial difficulties as older adults were, in large part because they had entered the workforce more recently and generally were less secure financially.

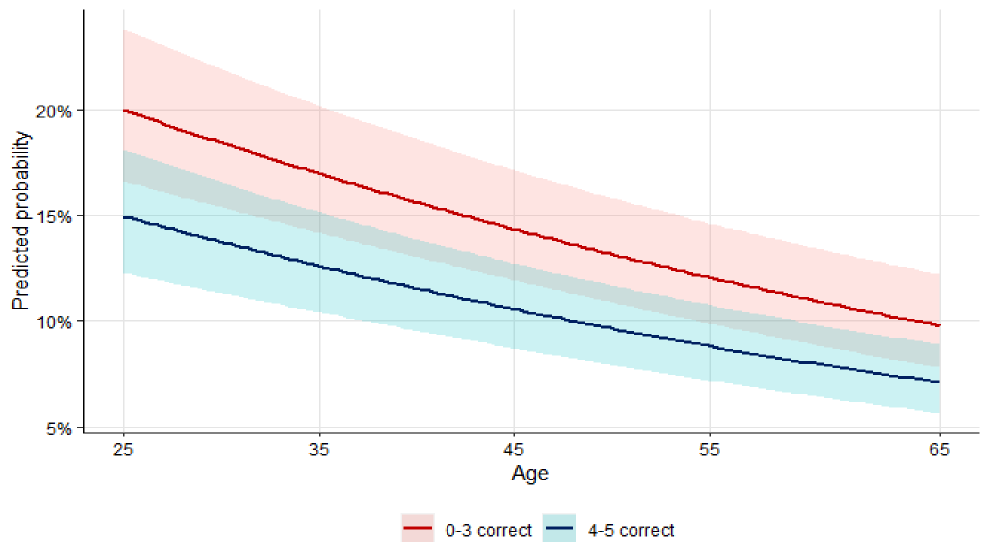

Figure 5. Predicted probabilities of late bill payment by age and level of numeracy. The figure shows the predicted probabilities with 95% confidence intervals. Estimates are based on the following settings: female, born in the UK, married or cohabiting, post-secondary education, working in Jan 2020, management/professional occupation, in good health, no disability, not on benefits, in rented accommodation, mean per capita household income, England. Source: Understanding Society (2019, 2021), Waves 1–9, 2011–2019, linked with COVID-19 Waves (2021).

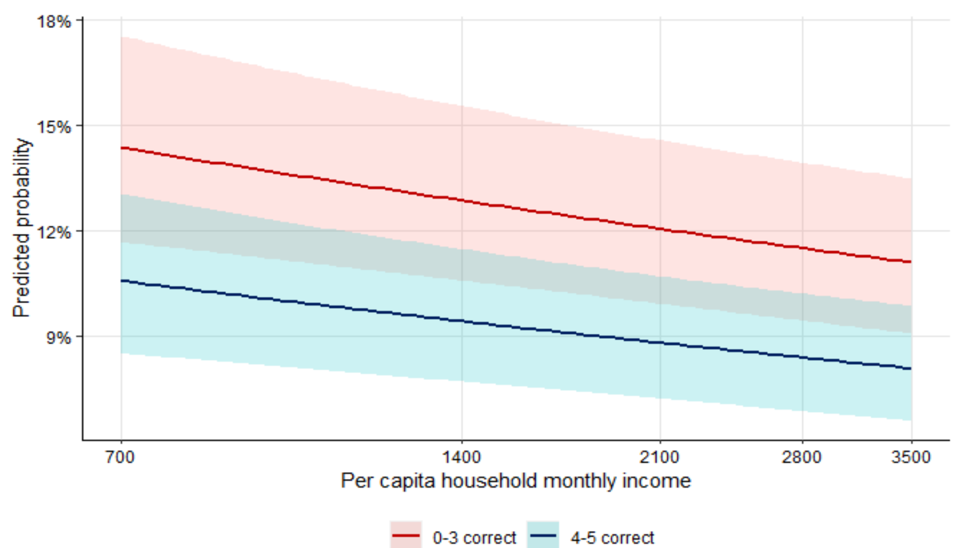

Figure 6. Predicted probabilities of late bill payment by household income and level of numeracy. The figure shows the predicted probabilities with 95% confidence intervals. Estimates are based on the following settings: mean age, female, born in the UK, married or cohabiting, post-secondary education, working in Jan 2020, management/professional occupation, in good health, no disability, not on benefits, in rented accommodation, England. Source: Understanding Society (2019, 2021), Waves 1–9, 2011–2019, linked with COVID-19 Waves (2021).

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I found no evidence of differences in the association between numeracy and financial outcomes by ethnicity, insofar as highly numerate individuals across ethnic groups fared better than did less numerate individuals, and by similar proportions. On average, the probability of missing one or more household bill payments declined by approximately one-third for numerate individuals. However, Figure 7 demonstrates that stark differences in risk of financial difficulties by ethnicity remained, regardless of numeracy level.

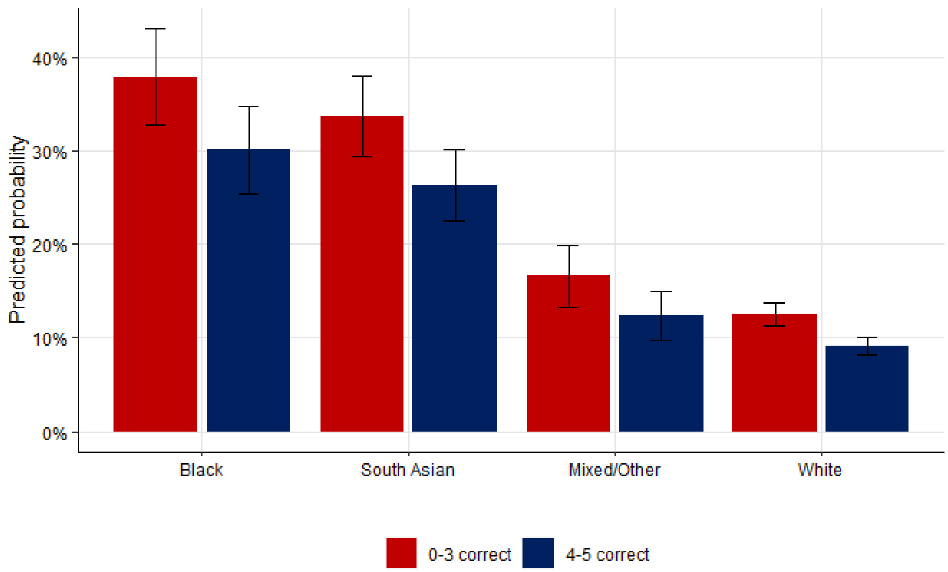

Figure 7. Predicted probabilities of late bill payment by ethnicity and level of numeracy. The figure shows the predicted probabilities with 95% confidence intervals. Estimates are based on the following settings: mean age, female, born in the UK, married or cohabiting, post-secondary education, working in Jan 2020, management/professional occupation, in good health, no disability, not on benefits, in rented accommodation, mean per capita household income, England. Source: Understanding Society (2019, 2021), Waves 1–9, 2011–2019, linked with COVID-19 Waves (2021).

Discussion

In this paper, I examined the relationship between numeracy and financial wellbeing, using outcomes that captured respondents' objective and subjective experiences of financial strain during the early months of the COVID-19 pandemic. The timing of the numeracy questions and subsequent outcomes enabled me to assess the long-term effects of high numeracy on financial behavior in the larger population. The logistic regression models yielded three main findings: First, despite nearly a decade having passed since respondents were assessed on their numerical ability, those who had scored highly on numeracy remained significantly

less likely to experience financial problems during the pandemic. These results held even when accounting for factors—such as age, income, home ownership, and education—that might account for links between numeracy and wellbeing.

Second, this protective effect appeared consistent across all levels of education, as well as across gender and ethnic groupings. The fact that a nationally representative sample found numeracy to yield generally consistent benefits, regardless of one's demographic characteristics, is very encouraging. As studies have considered ethnicity far less frequently than similarly relevant factors in the development of financial capability, the results from the ethnicity-stratified models are novel and promising. The findings extend previous studies that suggest numeracy reduces the risk of financial strain for families (Wiersma et al. 2020).

Nonetheless, it is important to highlight a third point, which is that numeracy on its own did not subvert patterns of social advantage. Rates of missed or late bill payments for numerate ethnic minorities remained higher than for Whites with low numerical ability (Figure 7). This suggests that improving one's numerical ability is likely to be a good strategy for anyone seeking to improve their financial situation, but it is unlikely to surmount disparities in educational opportunity, employment, and income (Angrisani et al. 2020; Platt and Warwick 2020; Park 2021). At the end of the day, stark differences by ethnicity remained for both objective and subjective measures of financial stress.

Certain demographic characteristics were strongly linked to difficulties paying bills, in keeping with research that has shown that young people, those who are less educated, and minorities were most vulnerable to income and job loss (Adams-Prassl et al. 2020; Brewer and Gardiner 2020; Crossley et al. 2021; Stavins 2021). Many of the groups most at risk of financial pressure were those whose livelihoods have been impacted disproportionately by lockdown restrictions and job losses, including ethnic minorities, the young, low-paid, and disabled (Foley et al. 2020). The elevated financial strains for self-employed individuals likely resulted at least in part due to the lack of support available to them, by comparison to the supports provided to other workers (Mayhew and Anand 2020). Recipients of social benefits continued to face straitened circumstances relative to those not in receipt of benefits, lending credence to concerns that current welfare supports remain inadequate to help families move toward more secure financial footing.

Despite the prolonged difficulties and uncertainties families have faced since the onset of the pandemic, in which many have had to adjust to job loss and reduced income, many respondents avoided serious financial challenges. People who were able to continue working as before, or who were not reliant on wage income, felt no major change in income (Brewer and Gardiner 2020) and therefore no change in their baseline risk of financial strain. There is even evidence to suggest a boost in saving rates among those who began working from home and could spend considerably less each week on transportation and meals outside the home

(Handscomb and Judge 2020). The UK's furlough scheme also played a critical role in bolstering households' finances during the study period. As a result, the percentage of people who found themselves without work and any other means to support themselves is smaller than would have been the case without the furlough scheme (Adams-Prassl et al. 2020).

Limitations

These results leave unaddressed the extent to which numerical ability causally accounts for variations in individuals' financial situations. An array of confounders that could explain links between numeracy and financial wellbeing were included in the models, which showed that numeracy influences bill payment and financial stability independent of the effect of income, benefit receipt, education, employment, and social context. Having said that, the long gap between when the numeracy items were asked, and the pandemic began, reduces the extent to which the findings are merely correlational.

It was not possible to determine to what extent respondents contributed to the management of household finances, but it is feasible that the sample included people with limited involvement in financial matters. These individuals may not provide useful insights into the relationship between numeracy and financial behavior, because other members of their household were responsible for managing their money. To mitigate concerns that respondents lacked the information needed to assess their family's financial situation, I used binary outcomes that captured objective and subjective financial strain, but which did not depend on respondents having detailed knowledge about their financial situation. I also drew on people's responses at three points in time to maximize recall.

On a deeper level, if knowledge of household finances correlated with numerical ability in this sample, the results may have underestimated the true association between numeracy and financial wellbeing. People who take an active role in managing household finances develop greater proficiency with numbers and financial matters generally than do partners who delegate that responsibility entirely (Ward and Lynch 2019; Bialowolski et al. 2020). Paradoxically, although taking a more active role in financial matters can be positive in terms of improving financial decision-making and knowledge, it also may expose one to financial realities that can lead to financial stress (Clark et al. 2021).

This study lacked data on the extent to which respondents felt confident in their numerical ability (Nitani et al. 2020), which is an important complement to objective ability (Balasubramnian and Sargent 2020; Sobkow et al. 2020). Peters et al. (2019) reported that low confidence may eliminate any benefits conferred by objective numeracy on financial outcomes. More troubling, those who overestimated their numerical ability not only did the worst financially but also misunderstood their financial situation, leading them to believe that they were

doing well financially. Balasubramnian and Sargent (2020) observed the same phenomena when studying the effect of financial overconfidence on problem behaviors, with the mismatch between ability and perception being most prevalent among the highest educated and high-income respondents. This mismatch between ability and self-appraisal could explain the muted effects of numeracy on financial comfort in Model 2.

There was a large amount of missing data for some items, primarily due to respondents exiting the COVID-19 surveys before they had reached the finance questions. Non-response was highest for the young, those with less formal education, and for Black and South Asian respondents. Implementing multiple imputation ensured the retention of these individuals in analyses. To help meet the MAR assumption underpinning multiple imputation, the imputation model incorporated a wide range of analytic and auxiliary variables that help explain differential rates of item non-response. The longitudinal survey weights account for changes in the sample composition due to attrition from the study. Appendix Tables A.2 and A.3 demonstrate that the survey weights and multiple imputation led to no substantial changes in the results.

Conclusion

Despite these limitations, and notwithstanding the need for further research, this study strengthens the evidence base linking numeracy to improved financial functioning. Given the spillover benefits on employability, health literacy, and general understanding, there are few tradeoffs to improving people’s skills and confidence with numbers (Parsons and Bynner 2005; Garcia-Retamero et al. 2019; Roozenbeek et al. 2020). Numeracy equips people with the skills needed to compare prices, manage bills, and keep expenses in line with income, which has a feedback effect on their level of confidence with numbers and with money. Successfully negotiating financial difficulties and changes in life circumstances sets people on the path to long-term financial wellbeing.

There is also likely to be no better time than now to invest in efforts to improve individuals’ financial capability: Debt and financial constraints are likely to remain a reality for many families going forward, as countries begin to recover from the COVID-19 pandemic. When the furlough scheme ends and businesses begin to reopen, many families who have been able to make ends meet thus far may find themselves in a much tougher financial situation (Blundell et al. 2020). Jobs that had been viable prior to the pandemic may no longer exist, or at the very least may take some time to return (Brewer et al. 2020; Mayhew and Anand 2020). Within the UK, Universal Credit reforms (in combination with financial difficulties at the governmental level) mean that benefit recipients are likely to face increasing uncertainty about the level and security of benefits. The recovery process will require many families to adjust their spending habits downward to reflect these

straitened circumstances. Numeracy appears to provide people with the skills needed to negotiate this type of financial pinch (Banks and Oldfield 2007; Skagerlund et al. 2018).

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Appendix

Using the *mice* package in R, I fit a survey-weighted multilevel imputation model with heterogeneous error variances to reflect the study's nested data structure (van Buuren and Groothuis-Oudshoorn 2011; Enders et al. 2016; Robitzsch and Grund 2021). The level-2 variable was the primary sampling unit, and the longitudinal sampling weight from Wave 9 was applied to the imputation model as a sampling weight (Robitzsch and Grund 2021). Auxiliary variables included the original numerical ability score from Wave 3 (range 0–5); employment status, per-capita income, and primary activity at the start of the pandemic; current personal and household income from the COVID-19 study Waves; primary sampling unit, strata, survey weight, and household ID. Provided that the imputation processes incorporate sufficient auxiliary variables alongside the core analytic items, MICE can be used successfully even when data do not fully meet the missing at random assumption (Collins et al. 2002; Grund et al. 2018; Madley-Dowd et al. 2019).

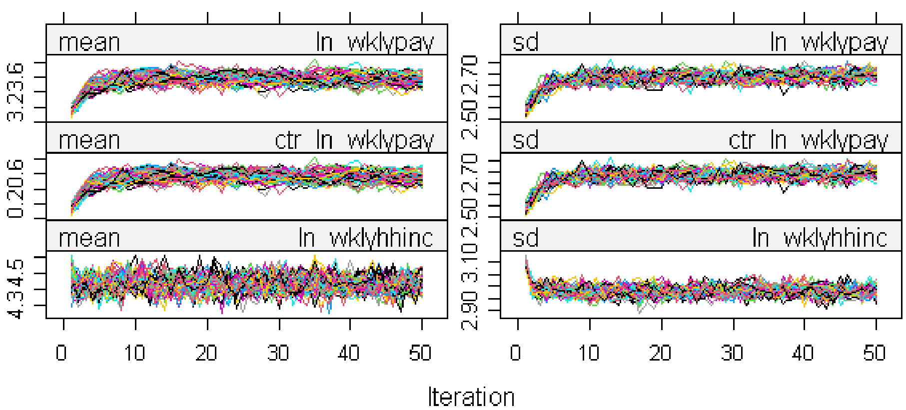

Fig. A.1. Example of the MICE algorithm convergence plots. Source: Understanding Society (2019, 2021), Waves 1–9, 2011–2019, linked with COVID-19 Waves (2021).

Due to high proportions of missing data for some variables, I generated 50 imputations, using 50 iterations of the imputation model to ensure convergence (Sullivan et al. 2015; Grund et al. 2018). The outcome variables were imputed alongside the other variables in the imputation model, and for the purposes of analyses, the cases with imputed values were retained in the sample rather than being deleted after imputation (Kontopantelis et al. 2017). Continuous items were centered and scaled to improve model performance. In the case of income-based items with non-normal distributions, the imputed values were constrained after imputation to fit within the range of possible values in the original variables (van

Buuren 2018). I used passive imputation to calculate the binary indicator for decline in household income over the period of lockdown.

Table A.1
Bivariate Associations between Predictors and Experience of Financial Difficulties

		Bill payment difficulties			Financial situation		
		All bills paid on time	Late/missed bill payment		Doing alright	Feeling squeezed	
Numeracy score	0–3 correct	74.6	25.4	***	53.6	46.4	***
	4 correct	84.5	15.5		66.9	33.1	
	5 correct	89.1	10.9		73.4	26.6	
Age		53.8	48.0	***	54.9	49.2	***
		(17.5)	(18.0)		(17.6)	(17.4)	
Gender	Female	80.5	19.5		61.0	39.0	**
	Male	81.5	18.5		63.6	36.4	
Ethnicity	White	82.4	17.6	***	63.6	36.4	***
	South Asian	56.8	43.2		42.9	57.1	
	Black	45.7	54.3		32.9	67.1	
	Mixed/Other	74.3	25.7		48.4	51.6	
Nativity	UK born	81.6	18.4	***	63.0	37.0	***
	Not UK born	73.3	26.7		53.7	46.3	
Relationship status	Married/cohabiting	84.3	15.7	***	67.6	32.4	***
	Single/not cohabiting	74.7	25.2		47.5	52.5	
Education	Post-secondary	87.6	12.4	***	71.7	28.3	***
	Higher secondary	79.7	20.5		61.0	39.0	
	Lower secondary	75.7	24.3		55.5	44.5	
	No formal qualifications	72.4	27.6		47.0	53.0	
Employment status	Employed	81.7	18.3	***	60.6	39.4	***
	Student or unemployed	63.0	37.0		42.3	57.7	
	Not in the labor force	81.8	18.2		66.9	33.1	
Health	Good to excellent	83.1	16.9		67.2	32.8	
	Fair to poor	73.6	26.4	***	45.8	54.2	***
Disability	No	83.1	16.9	***	66.4	33.6	***
	Yes	77.6	22.4		55.8	44.2	
Benefit receipt	No benefits	84.6	15.4	***	67.3	32.7	***
	Any benefits	56.7	43.3		28.3	71.7	
Household income	Per capita, monthly	2,014.1	1,588.6	***	2,157.8	1,563.3	***
		(1,495.8)	(1,723.5)		(1,633.0)	(1,325.3)	
Housing tenure	Own outright	88.1	11.9	***	79.5	20.5	***
	Own with mortgage	86.3	13.7		64.3	35.7	
	Rented accommodation	65.1	34.9		36.9	63.1	

Notes: Pooled results of 50 imputation datasets. Percentages are presented for categorical items; robust standard errors for the continuous measures appear in parentheses below the means. Standard errors adjusted for complex survey design which involves clustering, stratification, and oversampling. Population weights adjust for unequal selection and unit-response probabilities. Age and income are shown before transformations (e.g., log-transforming income, centering and scaling age and log(income)).
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Source: Understanding Society (2019, 2021), Waves 1–9, 2011–2019, linked with COVID-19 Waves (2021).

Table A.2
Comparison of Logistic Regression Results Predicting Late or Missed Bill Payment: Observed and Imputed Data

	III. Unweighted			IV. Survey weighted			I. Survey weighted, imputed		
	OR	*95% CI*		*OR*	*95% CI*		*OR*	*95% CI*	
Numeracy (ref. 0–3 correct)									
4 correct answers	0.79*	0.65	0.97	0.77*	0.62	0.96	0.72**	0.57	0.91
5 correct answers	0.62***	0.50	0.75	0.64***	0.51	0.81	0.59***	0.46	0.76
Age	0.81***	0.75	0.88	0.81***	0.74	0.89	0.80***	0.73	0.87
Male (ref. Female)	1.31**	1.11	1.55	1.20	0.99	1.45	1.34**	1.11	1.62
Ethnicity (ref. White)									
South Asian	2.62***	1.72	3.94	2.88***	1.65	5.02	2.64***	1.61	4.34
Black	3.74***	2.25	6.16	4.30***	2.36	7.84	3.45**	1.71	6.95
Mixed/Other	1.15	0.70	1.82	1.06	0.61	1.84	1.10	0.62	1.93
Nativity (ref. Born in the UK)	1.37*	1.01	1.84	1.37	0.95	1.96	1.41	0.99	2.02
Single (ref. Married/cohabiting)	0.93	0.77	1.14	1.02	0.79	1.30	1.14	0.91	1.41
Education (ref. Post-secondary)									
Higher secondary	1.15	0.92	1.42	1.16	0.90	1.50	1.23	0.95	1.58
Lower secondary	1.46***	1.20	1.78	1.57***	1.27	1.96	1.69***	1.34	2.13
No formal qualifications	1.97***	1.36	2.83	2.26**	1.41	3.63	2.44***	1.64	3.65
Employment status (ref. Employed)									
Student or unemployed	0.86	0.55	1.34	0.96	0.56	1.64	0.96	0.54	1.69
Not in the labor force	0.82	0.66	1.02	0.86	0.68	1.10	0.91	0.69	1.21
Housing tenure (ref. Own outright)									
Own with mortgage	0.87	0.70	1.07	0.85	0.66	1.09	0.88	0.68	1.13
Rented accommodation	2.09***	1.67	2.62	1.95***	1.50	2.54	2.03***	1.52	2.70
Log(per capita household income)	0.83**	0.74	0.93	0.86*	0.76	0.97	0.85*	0.75	0.97
Benefit receipt (ref. No)	2.12***	1.69	2.65	2.32***	1.79	3.02	2.01***	1.55	2.61
Loss of household income (ref. No)	1.27*	1.05	1.55	1.39**	1.11	1.74	1.14	0.96	1.37
Missing information	1.30*	1.06	1.60	1.33*	1.04	1.72			
Fair to poor health (ref. Good to excellent)	1.27*	1.03	1.56	1.21***	0.94	1.55	1.27*	1.00	1.61
Disability (ref. No)	1.26*	1.05	1.51	1.25*	1.01	1.55	1.28*	1.03	1.58
Country (ref. England)									
Wales	1.57**	1.16	2.10	1.64**	1.20	2.25	1.47*	1.04	2.08
Scotland	1.18	0.89	1.54	1.12	0.81	1.55	1.12	0.80	1.57
Northern Ireland	1.00	0.62	1.54	1.13	0.70	1.84	1.06	0.65	1.73
N	7,097			7,097			13,898		

Notes: The imputed data columns present the pooled results of 50 imputation datasets. Standard errors adjusted for complex survey design which involves clustering, stratification, and oversampling. Population weights adjust for unequal selection and unit-response probabilities.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

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Table A.3.
Comparison of Logistic Regression Results Predicting Feeling Financially Squeezed: Observed and Imputed Data

	V. Unweighted				VI. Survey weighted				II. Survey weighted, imputed			
	OR		*95% CI*		*OR*		*95% CI*		*OR*		*95% CI*	
Numeracy (ref. 0–3 correct)												
4 correct answers	0.78	**	0.67	0.91	0.75	**	0.63	0.90	0.77	**	0.66	0.91
5 correct answers	0.76	***	0.66	0.88	0.78	**	0.66	0.92	0.73	***	0.62	0.86
Age	0.95	*	0.89	1.01	0.99		0.92	1.07	0.92	*	0.86	0.99
Male (ref. Female)	1.08		0.95	1.22	1.09		0.95	1.26	1.15	*	1.00	1.33
Ethnicity (ref. White)												
South Asian	2.02	***	1.38	2.96	2.46	**	1.40	4.32	2.04	**	1.25	3.33
Black	1.99	**	1.22	3.24	1.82	*	1.02	3.26	2.04	*	1.07	3.89
Mixed/Other	1.57	*	1.07	2.30	1.57		0.96	2.56	1.56		0.93	2.62
Nativity (ref. Born in the UK)	1.27		0.99	1.62	1.21		0.89	1.66	1.35		0.98	1.87
Single (ref. Married/cohabiting)	1.30	**	1.12	1.51	1.35	**	1.12	1.63	1.38	***	1.17	1.62
Education (ref. Post-secondary)												
Higher secondary	1.30	**	1.10	1.52	1.28	*	1.06	1.54	1.34	**	1.12	1.61
Lower secondary	1.46	***	1.26	1.70	1.46	***	1.22	1.75	1.64	***	1.39	1.95
No formal qualifications	2.35	***	1.74	3.16	2.75	***	2.00	3.78	2.76	***	1.98	3.84
Employment status (ref. Employed)												
Student or unemployed	0.89		0.60	1.33	0.92		0.53	1.58	0.77		0.50	1.18
Not in the labor force	0.53	***	0.44	0.63	0.53	***	0.43	0.65	0.59	***	0.48	0.73
Housing tenure (ref. Own outright)												
Own with mortgage	2.02	***	1.73	2.36	2.01	***	1.65	2.44	1.96	***	1.64	2.35
Rented accommodation	3.79	***	3.17	4.53	3.73	***	2.97	4.68	3.50	***	2.83	4.34
Log(per capita household income)	0.50	***	0.44	0.56	0.53	***	0.44	0.64	0.55	***	0.47	0.64
Benefit receipt (ref. No)	2.94	***	2.41	3.60	2.79	***	2.16	3.60	2.63	***	2.06	3.35
Loss of household income (ref. No)	1.77	***	1.53	2.05	1.86	***	1.56	2.21	1.28	***	1.13	1.46
Missing information	1.30	**	1.10	1.52	1.39	**	1.14	1.69				
Fair to poor health (ref. Good to excellent)	2.00	***	1.70	2.34	1.92	***	1.57	2.34	1.94	***	1.62	2.32
Disability (ref. No)	1.23	**	1.07	1.41	1.20	*	1.01	1.41	1.23	*	1.05	1.44
Country (ref. England)												
Wales	1.01		0.78	1.29	1.21		0.91	1.60	1.09		0.80	1.47
Scotland	1.00		0.81	1.23	0.98		0.77	1.25	0.95		0.75	1.21
Northern Ireland	1.20		0.88	1.64	1.39		0.98	1.98	1.07		0.71	1.62
N	7,267				7,267				13,898			

Notes: The imputed data columns present the pooled results of 50 imputation datasets. Standard errors adjusted for complex survey design which involves clustering, stratification, and oversampling. Population weights adjust for unequal selection and unit-response probabilities.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.4.
Logistic Regression Models Predicting Late or Missed Bill Payment, Stratified by Ethnicity, Gender, and Level of Education

	Ethnicity		Gender		Educational attainment		
	Ethnic minorities	Whites	Females	Males	Degree or equivalent	Higher secondary	Lower secondary
Numeracy (ref. 0–3 correct)	0.71	0.68**	0.67**	0.70*	0.83	0.66	0.63**
4 correct answers	0.38*	0.57***	0.57***	0.55**	0.62**	0.49**	0.55**
5 correct answers							
Age	0.87	0.85***	0.85***	0.85**	0.83***	0.85**	0.86**
Male (ref. Female)	1.28	1.35**	--	--	1.42*	1.42	1.27
Ethnicity (ref. White)							
South Asian	--	--	3.38***	2.70**	2.72**	4.49**	2.65*
Black	--	--	3.90***	4.20**	4.42***	3.34	4.32**
Mixed/Other	--	--	1.43	1.07	1.25	1.18	1.36
Education (ref. Uni degree or equivalent)							
Higher secondary	1.59	1.25	1.32	1.20	--	--	--
Lower secondary/No formal qualifications	1.75	1.90***	2.05***	1.73**	--	--	--
Rented accommodation (ref. Owned home)	1.86	2.50***	2.64***	2.26***	2.15***	2.65***	2.56***
Benefit receipt (ref. No)	2.29*	2.22***	2.00***	2.51***	2.23***	2.18**	2.23***
N	931	13,071	7,465	6,538	5,628	2,798	5,577

Notes: Odds ratios presented here are based on the pooled results of 50 imputation datasets; sample sizes vary slightly by imputation for the analyses that group individuals by ethnicity or by education. Standard errors adjusted for complex survey design which involves clustering, stratification, and oversampling. Population weights adjust for unequal selection and unit-response probabilities.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

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