
What does numeracy add? Exploring financial literacy, numeracy and other skills amongst low-income adults in Canada and the UK

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ABSTRACT

There has been surprisingly little research about the role of numeracy in adult financial literacy, and the few existing studies available lead to contradictory findings. This paper takes a qualitative approach to explore the extent to which low-income adults in high-income economies use financial literacy and numeracy in their financial lives. Financial literacy is assessed in terms of three domains -- 'keeping track'; 'making ends meet' and 'staying informed' -- via semi-structured interviews and background information on participants. Participants are also categorised into three groups based on discussion about their numeracy: 'formally capable', 'informally capable', and 'uncomfortable'. Some participants exhibit elements of financial literacy but little or numeracy. There is no evidence that numeracy is essential, but having a variety of skills to draw on, potentially including numeracy, appears to be beneficial for low-income adults. The research contributes to the literature in two ways. It provides deeper understanding of the role of numeracy and also identifies two additional skillsets which appear to benefit low-income adults: digital skills and the ability to communicate clearly and advocate for oneself.

Keywords: Financial literacy, Numeracy, Low-income, Digital skills, Self-advocacy.

I. Introduction

There is no denying that discussions around money matters often require the use of numbers. However, despite evidence confirming the correlation between mathematics and financial literacy amongst 15-year-olds (OECD, 2014, 2017, 2020), there is significantly less compelling evidence of the relationship between financial literacy and numeracy across adult populations.

Indeed, whilst some observers argue that competency with numeracy is a critical ingredient in financial literacy (Skagerlund et al., 2018), others go as far as to argue that it is

irrelevant (French & McKillop, 2016). Consequently, there is currently no consensus opinion about the extent to which adults need numeracy to manage their financial affairs.

There are important policy reasons for exploring the role of numeracy in financial literacy. If financial literacy is closely associated with numeracy – a skill that is already taught in schools – it may be more efficient to focus policy attention on the content of mathematics lessons in schools, and the numeracy of adults. However, if numeracy is not pivotal, it becomes essential to identify the skills that are relevant and ensure that financial literacy initiatives promote their development.

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This paper therefore seeks to examine adult's financial literacy and numeracy through semi-structured interviews that can also provide insights into other skills used to manage money. To control for the potential for variations by socio-economic group, and since high-income individuals are less often the target of financial literacy initiatives (OECD, 2015), the focus is on low-income people making financial decisions for themselves/ and or their household.

The study addresses three research questions:

1. What is the role of numeracy in the financial lives of low-income people in Canada and the UK?
2. Are there other skills relevant to effective money management, that may be considered to be aspects of financial literacy?
3. Is numeracy an essential component of financial literacy amongst the people studied?

The paper contributes to the literature by identifying and examining the role of a numeracy and a variety of other skills that low-income people in two high-income economies with mature financial service sectors use to manage their money. It also recommends potential avenues for further research. The project received ethical approval from the Canadian Mennonite University and the University of Birmingham.

The remainder of the paper progresses as follows. First, a background section incorporates a brief discussion explores the various ways in which financial literacy is typically defined and its key components and an overview of the literature seeking to provide insights into the role of numeracy in various aspects of people's financial lives, including their financial literacy, money management and attitudes to debt. This is followed by a description of the research methods used. A detailed results section then explores the ways in which research participants evidenced financial literacy and numeracy and identifies other potentially valuable skills. The paper concludes with a discussion of the novel insights from the research.

II. Background

The term 'financial literacy' has been in use for many decades (OECD, 2005). For some, it is synonymous with financial knowledge (Lusardi & Mitchell, 2023). Those who view financial literacy in this way often speak of 'financial capability' when focusing on a broader set of competencies such as behaviour around finances or attitudes towards money (Atkinson et al., 2007). However, the two terms, 'financial literacy' and 'financial capability', are increasingly used interchangeably, and are both described as competencies required to achieve 'financial wellbeing' (Atkinson, 2022). This overlap in terminology is clearly illustrated by the OECD definition of financial literacy in adults, which includes knowledge, attitudes, skills and behaviour related to personal finances (OECD, 2005).

Early exploratory research on behalf of the OECD also identified domains in which people apply financial literacy: day-to-day money management; financial planning; choosing appropriate products and financial knowledge and understanding (Kempson, 2009, pp. 5–6). These draw on the development of a UK financial capability survey and subsequent data collection, which organises financial capability in terms of 'managing money', 'planning ahead', 'choosing products' and 'staying informed' (Atkinson et al., 2007, p. 31).

Variations in the use of terminology and definitions have an impact on the measurement of financial literacy. Whilst some researchers measure only financial knowledge when assessing levels of financial literacy, others apply more comprehensive measurement approaches such as the OECD/INFE Toolkit, which captures information about behaviours and attitudes as well as financial wellbeing and financial inclusion (OECD, 2022). Even so, researchers using either approach typically expect a financially literate adult to have knowledge of financial terms, products and services and to evidence numeracy in a financial context. They therefore incorporate numeracy

questions in standard financial knowledge tests, complicating attempts to understand its unique contribution to financial literacy (French and McKillop, 2016).

French and McKillop (2016) and Cao-Alvira et al. (2021) argue that it is money management, rather than skills such as numeracy, that is central to one's financial wellness. But Whiting et al (2017) find that numeracy levels predict both money management activity (savings behaviour) and outcome (amount saved) even after controlling for other factors. There is also evidence that numeracy is associated with higher order financially literate behaviours, such as investing in stocks or saving for retirement, and outcomes such as avoiding defaulting on loans (Estrada-Mejia et al., 2020). This suggests that money management behaviours themselves may be associated with numeracy.

Skagerland et al. (2018) introduce another important concept to the understanding of numeracy and financial literacy, mathematics anxiety. They argue that this anxiety uses up critical cognitive resources that make it more difficult for a person to engage in literate financial thinking and behaviour and that addressing it would enable greater financial literacy and action. However, Storozuk and Maloney (2023) do not find a relationship between mathematics anxiety and financial behaviour and conclude that enhancing numeracy would not help people to become more confident or increase behaviours conducive to financial wellbeing.

Whilst some of the literature suggests that numeracy is an important factor in determining financial literacy (Dituri et al. 2019, Estrada-Mejia et al. 2019, Graffeo and Bonini 2017, Skagerland et al. 2018), other studies conclude that numeracy is not essential (Cao-Alvira et al. 2021, Carpena and Zia 2020, French and McKillop 2016, Lind et al. 2020, Peters et al. 2019, Philippot 2020). Skagerlund et al. (2018), for example, found that the ability of adults in Sweden to understand numbers was key to them becoming financially literate. Yet econometric analysis by Cao-Alvira et al (2021) shows that numeracy levels are positively related with *higher* consumer debt levels, whilst money

management skills are positively related to lower debt levels. One explanation put forward by the authors is that numeracy skills led people to be overconfident about credit and accumulate excessive debt. This analysis also indicates that female-headed households and lowest-income households have lower debt-to-income ratios (Cao-Alvira et al. 2021). The authors do not raise the question of differences in access to, or awareness of, affordable credit.

It may be that the tension in the literature is related to psychological factors. One study looking at the application of numeracy in explaining self-reported financial outcomes suggests that being good with numbers alone is not enough, but the application of numeracy requires both the ability to manipulate numbers and the persistence to keep going when the task becomes arduous (Peters et al., 2019). It also identifies a significant risk in being overconfident with numbers. Research looking at the roles of confidence, competence and numeracy on financial literacy also indicates that numeric ability does not predict sound financial behaviour once other factors had been controlled for (Lind et al., 2020). However, the study suggests that confidence may be important for positive outcomes, since self-assessed financial knowledge predicts outcomes better than objectively tested knowledge.

III. Method

The lack of consensus around the role of numeracy in financial literacy in the largely quantitative literature suggests that a more in-depth study of people's financial lives would provide a valuable alternative perspective. The research described in this paper therefore applies a qualitative approach to respond to the research questions.

Semi-structured interviews with a small number of participants facilitated a thematic analysis approach, which offers a flexible yet structured way to organise qualitative data and interpret the results (McLeod, 2024). A purposive sampling approach was chosen, limiting the sample to low-income individuals

who were responsible for their financial decisions.

A. Sample

The aim was to create a sample that was sufficiently diverse to provide an opportunity to explore variations in the role of numeracy in financial literacy, whilst limiting the income parameter. The sample for this study comprises 13 adults based in the UK and Canada. Of these, six participants lived in or near to Birmingham, UK; and seven participants lived in various provinces in Canada. Based on the literature and the authors' combined experience of qualitative research, the sample size was considered to be sufficient to contribute new insights and understanding. The literature suggests that saturation can occur with as few as six interviews and that typically between nine and 17 interviews will achieve this (Guest et al., 2006; Hennink & Kaiser, 2022).

The UK participants were recruited by a specialist agency, using a short screening questionnaire to identify participants with modest incomes. The screener was used to ensure that: all participants were aged 18 or over, with at least one aged 34 or under, one aged 35 to 54 and one aged 55 or over; at least two identified as male and at least two identified as female; and that none had a personal income above £19,380 a year before tax. The Canadian participants were purposively sampled from an existing group of Canadian Financial Diary (CFD) participants.¹ The criteria for selection were that they had low income and fell into one of two categories for being able to manage financial transaction data, based on the researchers' extensive knowledge of the diaries they had submitted to the CFD project. These categories were a) those who maintained a higher quality financial diary (i.e., participant completed their own diary or used a template, and their data was all/mostly complete) and b) those who did not.

The UK participants were met on two occasions in order to build a deeper rapport

between the participants and the interviewers, with the intention of at least partially simulating that which had been created with the Canadian participants due to the CFD project. UK participants were also assigned 'homework' to complete before the second meeting in order to encourage them to continue to think about the topic during the intervening days, just as diary participants had become accustomed to thinking about their finances throughout the data collection period.

The final sample resulted in around 16 hours of audio data recorded across 19 interviews with 13 participants. Additional background data from the CDP was also available for all participants in Canada. This was the maximum amount of data collection feasible given financial and human resource constraints.

Table 1 presents the socio-demographic characteristics of the participants. Whilst the sample is purposely constrained in terms of income, it is geographically and ethnically diverse and varies across socio-economic characteristics. Across the final sample, nine participants identified as female and four as male. The average age of participants was just less than 44 years old. The educational range of participants ranged from not completing school through completing a university degree. Two Canadian participants were not born in Canada, and one identified as an Indigenous Person. UK participants included at least one who identified themselves as a first-generation immigrant and one second generation immigrant, but this was not discussed with all participants. One-half of the participants were employed and the remainder relied on employment insurance, social assistance, or pension income. By design, the participants had modest income. UK participants had personal income level below £19,380 (\$33,140 CAD) a year before tax, approximately 60% of median UK income. The average annual income for the Canadian participants was \$25,240 CAD (£14,760).² This is below the annual income threshold for poverty, using the Statistics Canada Market

¹ [Canadian Financial Diaries Research Project – A research project seeking to understand household finances to foster well-being](#)

² During the time of the field research the exchange rate between the pound and Canadian dollar ranged from 1.68 to 1.74 with an average of CAD1.71=£1.

Basket Measure, for a single person in the City of Winnipeg of \$26,532.³ Family size averaged at 3 persons and most participants rented their accommodation.

B. Data collection

Fieldwork was undertaken by the authors in the fall of 2023 and winter 2024. All UK and Canadian interviews were undertaken in English, and most, but not all, participants were native English speakers. All UK participants and most Canadian participants were interviewed by two researchers, and there were no other people present during the interviews. All interviews were recorded and transcribed with the informed consent of the participant.

UK fieldwork took place in the homes of six participants in September 2023 across several suburbs of Birmingham, a large city in England. Each participant was interviewed on two occasions, two weeks apart. The first interview lasted an hour, and the second one 30 minutes; none ran over. Participants were provided with gift vouchers totalling £70 at the end of the second interview to thank them for their time. Canadian participants received a \$60 honorarium and were interviewed for around one hour in Winter of 2024. Interviews were conducted by one or two of the three authors, either in-person or online.

All interviews were semi-structured, using topic guides that covered participants' knowledge and behaviour around numeracy and financial literacy. These covered household/personal situations, skills used (including numeracy) in a financial context, an exploration of broader skill set and then skills that would be most useful for managing money. UK participants were also asked to reflect on their use of numeracy in between interviews, where their attitudes to money had come from and how they saw their financial future.

Important contextual differences between Canada and the UK were considered during the application of the topic guides, including linguistic differences such as the use of 'maths' in the UK or 'math' in Canada, terminology such as 'current account' in the UK or 'chequing account' in Canada, and discussions of the respective financial landscapes.⁴

All discussions were recorded and transcribed by one of the project researchers, before being uploaded into NVivo 14 for analysis.

C. Analysis

Data were coded by the research team using an iterative process. First, a high-level coding structure was agreed by the research team before coding began. This reflected the definitions of financial literacy proposed in Atkinson et al (2007) and the UNESCO definition of numeracy (UNESCO-IBE, 2013). In practice, this entailed coding scripts that mentioned 'managing money', 'planning ahead', 'choosing products' and 'staying informed' and those that referred to the use of math skills in personal/social life, study, or work.

Once the initial structure was applied to the data, subcodes were added as themes emerged. All codes and excerpts were discussed by at least two researchers before being accepted in the analysis to minimise potential coder bias. Regular team meetings triangulated findings with the extant literature, providing opportunities to refine the coding. The data were then analysed to identify differences within themes, and participants were categorised, to the extent possible, according to their financial literacy and numeracy.

The results below use some verbatim quotes to illustrate specific topics. Where necessary,

³ Source: Hajer, J., & Apata, M. (n.d.). An Updated Calculation Guide for the 2022 Family Living Wage for Manitoba; and, Government of Canada, S. C. (2019, April 17). Market Basket Measure (MBM) thresholds for the reference family by Market Basket Measure region, component and base year. <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1110006601>.

⁴ Some differences between Canada and the UK include: Mathematics education is compulsory through grade 12 (ages 17-

18) in Canada and compulsory for students in the UK up to age 16; Basic bank accounts in Canada cost \$4-5 per month and limit transactions to 12-15 per month while in the UK, basic bank accounts are fee-free (as are most standard current, or checking, accounts) and do not limit transactions, although cash withdrawals may be limited; In Canada the value-added sales tax (GST, PST, HST) is added at the point of sales whereas in the UK, this tax is embedded in the price of the good on the sales floor.

certain information has been changed or omitted to protect anonymity.

IV. Results

In order to answer the three research questions, the data analysis explored: 1) the apparent levels of financial literacy across the sample, 2) the extent to which numeracy was associated with financial literacy, and 3) other, related skills used in people's financial lives.

A. Financial literacy

In total eight participants were assessed as having relatively high financial literacy and five were assessed as being relatively weak financial literacy (Table A.1; see Appendix). We found a similar share of people with stronger and weaker financial literacy in each country. This highlighted a considerable range of financial literacy in this respect across a small group of people.

Drawing on the financial literacy/capability framework described in Atkinson et al (2007), financial literacy was evidenced across the sample primarily in relation to Managing Money (keeping track, making ends meet, and financial control) and, to some extent Staying Informed. There was little evidence from which to assess the participants' competencies in Planning Ahead and Choosing Products.

Managing money includes keeping track, making ends meet and having a certain amount of control over one's financial situation. According to Atkinson et al. (2007) people are more likely to manage their money day to day than they are to plan for the future or stay informed of financial matters. Even so, whilst some of the participants in this research did exhibit excellent skills, they were not all competent money managers. Furthermore, even some of those who were attempting to manage their money were unable to maintain their financial wellbeing, due to various external factors.

Various organizational skills were evident when people discussed managing their finances. For instance, P7 talked about a few ways in

which she organized and planned her life. One way was that she carefully tracked her spending: "The daily thing with me, like I said, spend money on one day I will immediately write it down. Today I'm going to do my banking, of course, right here in front of me. So, everything that I have to pay out and everything that's coming in so right here (P7, 2023)." Her spending choices were deliberate, with little discretionary spending. But her organizational skills included other aspects of her life: "Well, you know, I was a legal secretary...I can tackle my documents for example (P7, 2023)."

However, the ability to keep track was not always sufficient to ensure positive outcomes. P9 believed that she kept track effectively, writing down: "Pretty much every penny I have. (P9, 2023)." However, she faced significant financial difficulties stemming especially from rent arrears. Her diaries interviewer had previously noted that she did not think or plan for the future, and spent quite a lot of money on substances. Whilst she claimed to keep notes of her spending, she had not been able to complete her diary and reported at the end of the diary process that she had learned nothing about her finances. In reality, her ability to keep track did not translate into a deep understanding of her financial situation or ability to manage her money effectively.

Participants often relied on poorly funded government supports, had poor job prospects, worked for near minimum wage, and (particularly in Canada) had inadequate banking products, all of which added to the challenge of making ends meet and controlling income and expenditure. It was within this context that several participants explained how they prioritized their spending needs. For instance, P1, a young man living with family members, talked about being intentional about his spending. In some cases, he decided against an expenditure and in other cases he decided for it, but, in either case, he was thoughtful about his action. His description of contemplating whether or not to buy an ice cream exemplifies the difficulty in making ends meet when even small treats come at the expense of meeting future bills:

“I don't care if the ice cream is two pounds more...I'm not going to hold myself back...But at the same time I'll also be critically thinking, thinking, is it really worth it? Is it - what if I'm doing this? If I decide, you know what, I haven't bought anything for a while...Then I'll think, yeah, but I've got that bill next month. (P1, 2023).”

P1 had built friction into his spending, in order to help himself to make ends meet by supporting mindful spending. He had asked his bank to provide a card that could not be used for contactless payments, as he preferred to take the time to read the screen and enter his pin number to pay. This shows a high-level of self-awareness and the ability to develop behavioural controls. P13 had also mastered spending control, and she claimed to value this behaviour as a source of simplicity in her life. She was successful in making ends meet, a very independent person and strong financial manager. However, she also recognized a downside in this financially literate behaviour, commenting “I don't know if I've just become too thrifty” as she recounted a story of how she had put her families wishes before her own.

Whilst P1 and P13 made ends meet through a combination of prioritization and spending control, P9 illustrates how prioritizing becomes painful, and may be insufficient, when income is meagre. In addition to accepting donations of second-hand clothes and turning to food banks, she shared that: “. But to do things like buy socks and undergarments or any other kind of clothing, for the most part, I have to sacrifice food to be able to get clothing and food is scarce as it is because by the time I pay all my bills and take care of all the other things you know, apartment insurance, etc, I have less than \$200 for the entire month for shopping (P9, 2023).” She also faced challenges due to addictions, which further limited her ability to fully apply her financial planning skills.

In contrast, P8, who had previously exhibited difficulty doing her financial diaries, spoke of difficulty prioritizing her spending:

“Like, I'd rather them just take care of my finances, like do everything for me. I don't

want to deal with it. I don't know how. I don't want to. I hate it. I love money. I love spending it. But I hate it. I hate having bills...But I do, I never pay them fully. You know what I mean? Like, I just don't want to have a responsibility. I know it's part of being an adult, but I absolutely hate it. And I'm not good at it. (P8, 2023).”

P2 also found it difficult to prioritize, and illustrated how complicated life could become for someone who was not able to manage money effectively. She had difficulty remembering key dates and values, resulting in her forgetting to pay her rent when due, or paying the wrong amount. She had no system in place to manage monthly outgoings and appeared to be at the mercy of her private landlady.

In general, it is evident that money management benefited from a confidence in handling money values, and the ability to manipulate numbers. This will be discussed further when looking specifically at numeracy.

The literature on financial literacy and capability does not anticipate that people become experts in financial matters. Typically, some mention is made to staying informed, which might include following the news but also being aware of where to get help or advice (Kempson, 2009). Consistent with this, most participants were aware of the current economic situation, speaking of the practical implications of the cost-of-living crisis, typically without referring to interest rates or inflation. They also all had some idea of where to find information, advice or help when needed, indicating a certain amount of financial literacy in terms of ‘staying informed’. Their strategies themselves ranged from the less reliable option of asking friends or family for support, through using the Internet to answer simple questions, to recognizing the benefit of formal advice, and some only sought help when things were already at crisis point. Furthermore, as with managing money, knowing where to get help, and even asking for help was not always sufficient to maintain financial wellbeing.

P2, for example, often looked to family members for information and practical help,

while P1 noted that he regularly used a virtual assistant on his phone to solve problems (including math problems, as illustrated here): “What’s 8% of 480 say, yeah, I’ll just even ask it. Sometimes I’ll just say, Hey Siri, and then Siri gives you the answer, so I just move on (P1, 2023).” And when P7 was asked, hypothetically, what she would do if she received a lump sum of money for investment, she was clear that for “things like that I most certainly would” seek advice. In each case, the participant recognised that an external tool or support mechanism was available. However, relying on friends and family can be problematic if their knowledge is poor or they are not available when needed.

Seeking help sometimes required a significant investment and did not always go according to plan. P6 had used the same bank since childhood and saw it as a source of information. She was therefore upset when she went into the branch but was unable to get the help she needed: “I mean I went recently to ask them if they could give me any help, but it’s, everything’s done by AI computer. It was like, ‘well no we can’t [...]’. Yeah, it was upsetting (P6, 2023).” P5 had also had a negative experience when seeking help. Having spoken to friends about her problem debt she had contacted a (well regarded) non-profit debt advice service. Despite taking leave from work to go through a debt management process with them she still felt overwhelmed and did not feel that she had received the help she needed; she also did not seem able to tell the adviser what she needed. Whilst seeking help may be considered financially literate, her experience shows that identifying sources of support was not sufficient for positive outcomes.

Whilst P5 lacked confidence, P3 demonstrated how a combination of confidence and a lack of curiosity might also get in the way of seeking support. When asked if she would speak to a professional in a bank or similar environment she responded: “I probably wouldn’t, to be honest with you. No, don’t think they would teach me anything new (P3, 2023).” In this case, P3 had assessed her own financial literacy in terms of ‘staying informed’ as adequate, but this self-assessment left her open to negative outcomes.

B. Numeracy

The data were also analysed to better understand how participants used math skills in personal/social life, study, or work. The analytical exploration of math skills data led to a preliminary categorization of participants according to the extent to which they had formal numeracy skills and the confidence to apply them.

Participants had varied experiences of learning about, and using, numeracy. Some participants were quite comfortable working with numbers while others were quite uncomfortable. Equivalently, some participants were more comfortable than others with formal mathematics. These have been categorised into three groups which differ in terms of numeracy competence and confidence to a greater or lesser extent (Table A.1. supplementary material). The labels are not meant to indicate hard and fast rules for mutually exclusive groups, but rather points on a scale of numeracy.

- **Group 1 - Formally capable:** This group comprises people who stated that mathematics was a strong subject for them during schooling or studied mathematics, accounting or book-keeping beyond compulsory education and are consequently (relatively) confident with numbers. However, even in this group some complained that they had lost skills over time.
- **Group 2 - Informally capable:** People in this group were confident with numbers but had no specific training. It includes people working in sectors that required basic numeracy, such as stock control.
- **Group 3 - Uncomfortable:** This group was neither trained nor informally skilled. The group includes one participant who saw themselves as better at languages than mathematics, and one who did not complete compulsory education.

Group 1 had higher levels of numeracy and confidence in applying their skills. Some were

grateful for the foundation training: “I have a background. I learned in the university I studied. So thank God I, I'm OK with that. I'm very disciplined. Otherwise I couldn't survive (P11, 2023).” P13 exemplified the complex relationship that some people have with formal education in subjects related to numeracy or money management (P13, 2023). She achieved a very high grade in accounting at high school, but strongly disliked the subject despite enjoying mathematics more generally. Yet, whilst she had not enjoyed accountancy lessons, she exhibited sound money management strategies, applying numeracy in a practical manner in her financial life.

P10 has also been classified as Group 1. He reported that math had been one of his stronger subjects in school and he had experience of managing a float and calculating tips, making him confident handling large sums of money (P10, 2023).

Group 2 comprises those who had learned less in formal education but illustrated or discussed relevant competencies, including for example P7, the legal secretary discussed in relation to financial literacy. This group were confident with a spreadsheet or calculator, and some used digital tools to get the results to simple calculations. They had acquired useful techniques to manipulate numbers in ways that were useful to them, including for measurement, cooking and money management.

People in the first two groups were comfortable working out how much they owed if they were sharing the cost of a meal out with friends, could calculate or estimate percentages and were confident in shopping around for good deals. Some described how they addressed necessary calculations in everyday life. Some had precise approaches. For example, one participant (P1) with higher level mathematics explained that to calculate an 8% discount he would calculate 1% first and then multiply by eight. People in Group 2 typically identified calculations that they would attempt, such as working out what 10% of something, or ‘doubling’ a value, but some lacked confidence in doing anything more complex. One explained

that calculating 10% required “moving the decimal (P5, 2023).”

Group 3 describes three participants who did not find it easy to apply mathematical skills in their everyday life, P2, P3 and P8. The range from one who lacked confidence (P3) through to one who was uncomfortable even thinking about numbers (P2). This group didn't trust their own mathematical skills, even though – in the case of P3 – money management was not a problem. In practice, lacking confidence meant that the participant was not happy to rely on their own estimate of a sum and relied heavily on their calculator. There is some evidence that people in this group were less likely to think of mathematics as having different levels of complexity. For instance, one did not differentiate between basic numeric operations and other aspects of mathematics, referring to them all as “algebra” as if to dismiss numeracy as an impossibly abstract concept; whilst another immediately (physically) recoiled at the word ‘numbers’: “It just reminds me of maths and I hate maths” (P3, 2023). Some made mistakes when trying to discuss calculations during the interview (for example one commented that 3 times 3 equals 6). However, even in this group, a UK participant who considered themselves to have no numeracy skills and initially recoiled at thinking about numeracy, illustrated an ability to undertake multiplication quite naturally when they told the interviewers: “I'm putting like 10 pounds a day in that meter. And that's a day - that's like 70 pounds a week! (P2, 2023).” This illustrates a possible tension between confidence and competence, discussed more below.

All participants were asked about their experience of mathematics in formal education and the way in which they use numbers now, including how they make quick calculations. Many also discussed practical applications of mathematics such as checking their bank statements, comparing prices, tracking spending or creating a budget. Whilst several described how they estimated sums in their head, it was more common for people to mention using a calculator from time to time (typically on their phone). Some also commented that they needed numeracy in the workplace in variety of ways such as handling money or monitoring stock.

There is some evidence from the analysis that the same person can have varying levels of confidence across different domains (e.g., numeracy related to formal math, numeracy related to puzzles, numeracy related to sewing or knitting, numeracy related to food purchases and preparation). The data suggests that some people tend to repeat certain operations in certain domains more frequently, building the necessary skills and confidence over time. This is especially the case with buying and preparing food. Many participants across the three numeracy groups (described above) spoke about budgeting for food, calculating the unit cost of foodstuff and preparing recipes by weighing ingredients. For them, manipulating prices, weights and measures had become an everyday factor of life, not one they particularly associated with mathematical prowess. In contrast, as one participant noted, skills such as using the 24-hour clock were not practiced so often which could lead to mistakes.

However, two participants in the third numeracy group reported that they were uncomfortable even using measures in cooking. Whilst in Canada, measuring cups provide an alternative to apportion various ingredients without weighing them, in the UK ingredients are almost always described in terms of their weight, if solid, or volume, if liquid. This meant learning recipes in other ways, such as copying approaches shown online or approximating volumes and weights by experience.

C. Other skills

This analysis provided a clear indication that numeracy is not the only skill that people employ when dealing with their finances. In particular, two other skills stood out. The first was digital skills, identified as a confidence with digital financial services, and the second was an ability to communicate clearly and self-advocate.

Digital skills have recently been identified as relevant to financial literacy (Atkinson, 2022). Participants illustrated several ways in which they had used their digital skills to support their financially literate behaviours, such as keeping the cost of banking as low as possible and keeping track of outgoings. Some had found that whilst they had the skills, the digital tools

available did not meet their needs. For a smaller group, a lack of digital skills and low confidence prevented them from benefiting from any positive elements.

Digital banking and paying have become common in Canada and the UK. Participants discussed their willingness and ability to access digital financial services and their confidence in using them. Common activities our participants referenced included using internet banking to track their account or move money, the use of banking apps and using their phone, debit or credit card to pay via the tap function. One participant was uncomfortable with all aspects of digital banking, some participants were not comfortable with digital banking beyond the very basic, while other participants got involved a little more, such as using an app to comparison shop.

In Canada, one of the advantages of digital banking is the lower fees. Consequently digital confidence was directly associated with cost-saving and an important part of money management for some. One participant noted, "So it's no banking fees, which is nice (P12, 2023)." In contrast, for example, P7 was limited to: "ten [financial transactions per month] and it's [the fee] \$3.95 a month." P11's debit card also limited spending "but [the account] have 12 transactions, so I have to be aware." This is not a consideration in the UK where banking is typically fee-free, although some UK participants appreciated fee-free currency options on digital banking: "Well there's a Monzo account you can have because we're going abroad next year. You don't have to pay the fees. So, I'm thinking if I get that, that will stop me paying the fees (P3, 2023)."

Digital skills and confidence made life easier for some. P4 found it useful that he received alerts from his phone provider when payment for his phone bill was due to be taken from his bank account. P3 explained: "I don't take a bag out so we don't actually have a purse or anything so I think it is good if somewhere and you need to obviously pay for something and you don't have your card, but I don't ever use my card now I think. Because I just use my phone so it's easier. (P3, 2023)." She reflected on how much harder

it would be to operate in cash: “I don't think I'd like that. Just having cash because I'd be having to be in a supermarket trying to work out what I'm spending because I've only got this amount or so (P3, 2023).” P3 also found the tools provided by her bank to be useful for managing money, noting “But I have a notification that says your standing order is about to be paid or that kind of stuff...[].It's really good, actually. Yeah. Rather than having to have to keep checking regularly or having a surprise when you're looking for (P3, 2023).” It is relevant to note that she is one of the participants who was uncomfortable using numeracy (Group 3).

P10 also found that digital tools were beneficial – in his case for paying bills. P10 was unemployed, rented a home in low-income neighbourhood, and relied on income support from social assistance and the support of his family. He carefully budgeted, collected points at stores, bulk shopped when there are sales, stocked a freezer, and valued frugality. But because of his low income, once he had used his money to pay bills and buy food, he then had no money for the rest of the month, unless he managed to make money informally on items he had bought to resell. Regarding his comfort with information technology he noted,

“Yeah, like I do like I have the app for my bank, and I do all my payments for all my bills through my bank...I do everything through my phone. (P10, 2023).”

Whilst digital skills and confidence appear to have a positive influence on people's financial lives, the available digital tools did not always provide the types of support that low-income people needed. For example, some online banks offered a ‘roundup’ service, automatically paying a certain amount into a savings account. As one Canadian participant noted: “it's not very useful when you're on a budget like myself (P9, 2023).” Similarly, as mentioned previously, P1 found contactless payments did not provide the level of spending control that he needed.

Digital skills and confidence were not universal. Amongst those with low levels of experience with digital tools was P13, a single, middle-aged woman who works two part-time

jobs and lives in a low-income neighbourhood. She did not use internet banking and minimized the use of digital finances and payments. She justified her digital exclusion alongside various other forms of exclusion, in part due to a lack of need and in part due to her stage of life, commenting:

“I don't have cable. I don't have Internet. I think if I had them that might cause me problems. I may just isolate myself more. I feel that, you know, my life is a little bit isolated. It's hard for me to go out of my, my comfort zone anymore, I think that's just where I'm at. The stage of my life. Everybody always talks about having Internet being a benefit and yes, I agree that there are benefits. But how is it going to help me? (P13, 2023).”

P13 also exhibited a lack of trust in the very idea that some financial service providers might offer lower fees. When asked whether she would switch to a hypothetical low-fee account, she responded: “I can't see that happening honestly. I've been paying this amount for a long time...” (P13, 2023).

Being aware of the risks of digital financial services was also important. For some, these outweighed the benefits, as illustrated by P2: “[My mum was] telling me I should do that and [then she had] I think it was like £2000 [taking by scammers]. That's a part of a bank, on online and I thought ‘see, that's why I won't do it’. And I'm, I'm more adamant now I'm not doing that because I don't need my money to be taken (P2, 2023).”

Participants also spoke about times when they had applied a skillset related to communicating needs or advocating for themselves (or, in some cases, advocating for family members and peers). They sometimes faced barriers that affected their life in general, or their financial wellbeing specifically, some of which could be overcome by asking for help, applying problem-solving skills (see below) or self-advocacy. Some participants were good at applying these skills while others found it more difficult.

P1 was good at advocating for himself when the electricity meter was misread by the utility

company, although he did not see this as a skill he used regularly. His determination to get the service he expected appears to have been driven by frustration that someone was not doing their job properly. He explained: "I'm quite stubborn with certain things, especially when it comes to them type [i.e. people who don't do what they are paid to do], 'I'm not doing your work, you are the one that over charge[d] me' (P1, 2023)."

P13 had found herself in a position of needing support during the pandemic and proved herself capable of stating her needs, as she explained: "It was actually on your own accord if.. if you needed funds you had to do it monthly, you had to do a phone call; I did the phone call (P13, 2023)." She thought she would probably also be prepared to complain if she received poor service from her bank (she paid a high premium for her account): "Yeah. If they denied me that or wanted to charge me extra, I would have a problem with that. And I would probably mention that to them (P13, 2023)."

P3 and P4 both talked about speaking up on behalf of others. P3 had considerable experience of doing this for the children in her care at work and on behalf of a vulnerable family member. P4 advocated for his fellow residents at his housing complex. He had spoken on behalf of the residents committee for four years, demonstrating leadership and confidence in public speaking:

Interviewer: "So did you organise the petition?" P4: "Me, my other two colleagues, we used to go around knocking on people's doors and getting the [petition] signed, forward it to them and also try to get the rent down... [and then shared it with] the MP for this area. (P4, 2023)."

In contrast, P5 struggled with advocating for herself, as mentioned in regards to 'staying informed'. She also described her frustration when faced with spiralling fines for driving in a zone she needed to pay for: "I think I've got two or three and one day and I was like Oh my God. So I've paid them £360 or something. And then the next day I woke up and I was like Oh My God, and there was more and it's like well this is like six £700 worth of clean air zone charges.

Like there's no number to contact them. There's no one to speak to. Everything's online and it's pretty much online. Pay it or or... or don't. And then, yeah, I was like, I can't. Can't keep paying them. They're gonna have to come and take the TV or something. I don't know. And then like literally, yeah, debts just kept spiralling out of control (P5, 2023)." Her inability to stand up for herself and communicate her needs, exacerbated by the digitalized approach, was clearly detrimental to her financial wellbeing.

P8 faced language and cultural barriers and lacked confidence in speaking to people in financial institutions, noting: "In my head, I can't make sense of that, and I don't know how to talk to bankers and that (P8, 2023)." With the help of a support worker she was able to have the conversation but did not work on the advice given: "I think understand what was going on but I didn't do like I said, I didn't follow up so I could be in a better financial situation five years from now (P8, 2023)."

D. How financial literacy, numeracy and other associated skills combine

The previous sections have looked at financial literacy and numeracy, as discussed by and observed across participants, and other skills that became evident during analysis that appear to be associated with financial literacy. Looking at these together, various patterns emerge (Table A.1. in supplementary material).

All the Canadian participants had previously participated in the CFD research project. This makes it possible to compare between self-assessed skills discussed in the interviews for this project, and previous financial diary/management quality. From this sub-sample comparison, it is clear that the quality of diarist-manager was not directly related to numeracy skills. There was a consistent positive relationship among the four strong diarist-managers: good diarist-managers reported that they were numerate, particularly in informal numeracy. All four of these diarists reported strength in using numbers in regular life, and all but one (P7) reported strength in formal mathematics (e.g., high school math). The relationship is more complicated with the three participants who were categorized as weak

diarist-managers (P8, P9, P12). In one case, P8, the diarist self-assessed as weak in informal numeracy but did well in high school math. In the other two cases (P9, P12), the weak diarist-manager assessed themselves as strongly numerate. But these two diarists did not fill out their own diary, they sent in their bank statements. They often could not explain the use of cash withdrawals, and they had debt and spending challenges (i.e., spending beyond their income and accumulating debt). These two diarists were not highly motivated to participate in the diaries process and did not appear motivated to carefully manage their finances. Similarly, they were apparently not motivated to apply their numeracy skills to their financial diary and management. P8, on the other hand, was motivated to participate in the diaries process but faced a barrier in examining and managing finances.

It is striking that several participants exhibited all the positive attributes discussed in the previous section (P1, P4, P6, P7, P10 and P11). None of this group spoke of burdensome credit, but their financial situations were delicate and some were reliant on external support. Interestingly two participants exhibited most of the attributes, but did not have numeracy skills (P3, P13), suggesting that it is possible to exhibit financial literacy without being competent or confident with numbers.

At the other end of the spectrum, whilst nobody had no positive attributes, two had only one (P2 and P8 only knew where to seek information or help). Both were extremely vulnerable and stressed by their financial situation. The remainder of the participants exhibited a number of strengths, and only one of these had weak numeracy (P3). P3 was also the only one with a long-term planning horizon, suggesting that it is not simply comfort with concepts such as compound interest that encourages longer planning horizons.

V. Discussion

Semi-structured interviews have made it possible to explore money matters and numeracy in a way that resonated with people living on a

low-income. Rather than ask test questions about compound interest or inflation to assess financial literacy and/or numeracy, this qualitative approach shone a spotlight on various skills that might otherwise have gone unnoticed. These include numeracy and skills related directly to managing money and making ends meet, but also a) an ability to use digital tools and b) communication and self-advocacy skills. These two skillsets were relatively commonplace and seemed to help several participants to juggle their complex lives. They complemented the elements of financial literacy more commonly discussed.

These findings expand on the extant literature related to financial literacy and numeracy by showing that numeracy has a role in the lives of many low-income people in Canada and the UK, but that it is not the only skill that they rely on in their financial lives and it may not be the most important. This suggests that financial literacy and numeracy do not automatically co-exist. It is relevant to note that several participants felt that they had acquired numeracy in informal ways in adulthood rather than through their formal schooling. Yet, some adults were not numerate, despite exhibiting the other attributes discussed, suggesting that some people who are capable of learning new skills find it difficult to acquire numeracy.

This study has shown that numeracy is just one possible skill that people use to manage their finances, and that it is not a pre-requisite for financial literacy, or even an essential component of financial literacy. Some people who are not numerate develop their other skills or apply work arounds (e.g., having a trusted advisor). Essentially, it appears that numeracy is not, in and of itself, a substitute for financial literacy, but that it might be possible to overcome a lack of numeracy by strengthening various other skills.

There appear to be several protective and confounding factors in the financial lives of the low-income participants of this study.

- People are protected from the worst outcomes when they have either a) family support or b) a strong social network.

- Family support, in particular, was common across the sample, but those without it, such as P5, fared less well. Having close social or family bonds helped some participants to overcome certain skill deficits, although family responsibilities also caused expenditure strain for some.
- Social support, in the form of food banks, was vital to several participants, possibly replacing the ‘rainy day savings’ that wealthier cohorts might rely on.
- Resilience is also important. Despite the challenges faced, most participants demonstrated high levels of mental resilience and were able to find solutions to every day financial challenges. We saw lots of evidence of participants making regular, sound, short-term financial decisions.
- Stress and a lack of confidence appear to be associated with negative outcomes.
- When asked, many of our participants rated their numeracy as low (‘rubbish,’ ‘awful’) leading to low confidence and possibly anxiety. But when we probed further and asked participants about ‘everyday’ number manipulation, most participants were more confident (and less anxious). We conclude that most of our participants find ‘work-arounds’ (around their math limitations) to manage their money.
- Confounding factors make it hard, irrespective of skills. The most striking of these amongst the 13 participants of this project were addiction, ill health or disabilities and very low income; issues that frequently co-exist. Even highly skilled participants with addictions, such as P9, could not make ends meet on a very low income whilst they spent on their habits.
- Being in a low-income and low-asset position also made it more difficult for the participants to behave in ways considered to be financially literate. This

is because the financial literacy needs are different when one’s income and assets are relatively low (as compared with having middle income and middle assets) and because being low-income is generally associated with financial and economic exclusion.

This study relies on a small sample and is not intended to be representative of any particular group. It is not possible to conclude from this study that financial outcomes are associated with a particular level of financial literacy or numeracy. However, the small sample adequately highlights the complex combination of skills being applied in people’s everyday financial lives. Furthermore, it illustrates all too clearly that people on low incomes face multiple financial challenges, and the best skills in the world will not prevent them from facing hardship in the absence of an adequate social security net and supporting policy framework.

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Table 1: Socio-economic characteristics of research participants

Code	Gender	Age (at time of interview)	Education	Nation of birth / Identity	Employed	Income	Household	Housing
P1	Male	Younger	University degree	First generation immigrant	Full-time employed	Less than £19,380 a year	Responsibility to extended family	Living in parent's home
P2	Female	Middle	NA	UK	Social assistance	Less than £19,380 a year	3 persons: 1 adult & 2 children	Rent
P3	Female	Younger	Incomplete schooling	NA	Part-time employed	Less than £19,380 a year	Partner in multi-generational household	Living in parent's home
P4	Male	Older	NA	NA	Retired	Less than £19,380 a year	1 person	Rent
P5	Female	Middle	NA	NA	Part-time employed	Less than £19,380 a year	2 persons: 1 adult & 1 child	Rent
P6	Female	Middle	NA	NA	Part-time employed	Less than £19,380 a year	2 persons: 1 adult & 1 child	Rent
P7	Female	67	NA	Canada	Retired	\$20,243	1 person	Subsidized co-operative housing
P8	Female	39	High school	Canada; Indigenous person	Full-time employed	\$42,000	5 persons: 1 adult & 4 children	Rent
P9	Female	53	High school	Canada	Social assistance (disability)	\$14,000	1 person	Rent with Roommate
P10	Male	41	NA	Canada	Social assistance	\$12,000	1 person	Rent
P11	Male	54	University degree	Newcomer to Canada	Employment insurance	\$20,000	2 persons: 1 adult & 1 child	Rent
P12	Female	35	Vocational diploma	Canada	Employment insurance (Maternity leave)	\$51,438	2 persons: 1 adult & 1 child	Rent
P13	Female	53	Incomplete schooling	Canada	Part-time employed	\$17,000	1 person	Rent

NA = Data are not available. Fewer demographic details were asked of the UK participants due to the difference in recruitment procedures.