Undergraduate student financial education interventions: Medium term evidence of retention, decay, and confidence in financial literacy

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A B S T R A C T

University is a significant transition period for young adults as they seek and gain independence, including financial independence. This would appear an ideal teachable moment for delivering financial education, though evidence of financial education intervention outcomes is mixed. We report medium-term empirical evidence, three years after the completion of an undergraduate personal finance semester-length unit, evidence notably absent in the literature. We find students retain significant objective and subjective financial literacy effects, with modest decay, three years after completing a unit of personal finance education. Effects on behavior and behavior intentions are less robust over time as boosts reported immediately after completion dissipate three years hence, though in absolute terms positive behaviors remain high. We found little evidence to link completion of a unit of study with overconfidence, as has previously been suggested, and students overall appear more discerning in their search for financial information sources after the unit.

1. Introduction

University enrolment represents a significant milestone for young adolescents as they transition to adulthood and confront all the attendant opportunities and responsibilities this brings, including those involving finances. Important aspects of "autonomy will be laid down during the college years" Shim et al., 2010. While acquiring the knowledge and skills to enable themselves to take on these responsibilities, most students remain financially dependent but identify becoming financially independent as a key marker of adulthood (Arnett, 2015). The undergraduate years, therefore, appear to present a teachable moment when students could acquire financial knowledge and skills, as well as develop the attitudes and behavior required for financial independence. There is "an urgent need" for countries to improve the financial literacy[1] of students at all levels (OECD, 2017) and to add courses to university curricula specifically for that purpose (Lusardi and Wallace, 2013).

It is therefore surprising that there is only sparse empirical evidence of the medium to longer-term impacts of university level

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[1] Financial literacy is used to refer to 'a distinct and different construct from financial decision-making, financial behavior, financial outcome/ well-being, and financial education' (Finke and Huston, 2014). We prefer the definition of Remund, (2010): "a measure of the degree to which one understands key financial concepts and possesses the ability and confidence to manage personal finances through appropriate short-term decision-making and sound, long-range financial planning, while mindful of life events and changing economic conditions."

financial education interventions on students. This is the primary contribution of this paper. We assess the persistence of positive changes in students' financial literacy following their study of a personal finance unit. This includes students' objective knowledge, self-reported financial behaviors, positive financial behaviors, and financial information search. We also explore students' subjective assessments of their own financial literacy, their confidence and over-confidence in dealing with finances. Indeed, Willis (2013) has suggested overconfidence is an unwanted outcome of financial literacy courses.

The "intuition" that financial education should improve financial decision making has led to the development and delivery of financial education interventions (Fernandes et al., 2014). However, initial meta-analyses failed to provide "compelling" evidence (Kaiser and Menkhoff, 2017) in support of the intuition. The documented correlation between *measured* financial literacy[2] and positive financial outcomes (e.g. Hastings et al., 2013; Miller et al., 2014) has "done much to confirm the causal impact of financial literacy on economic decision-making" (Lusardi and Mitchell, 2014). Lusardi et al. (2017) suggested that, in addition to individuals' wealth differences due to variations in permanent income and chance, they can "attribute another 30–40 percent of wealth inequality to financial knowledge" via the "endogenous variation in the returns that people can obtain on their savings, particularly on information-intensive assets" (Lusardi et al., 2017).

The evidence for the long-term effects of financial education interventions, or *manipulated* financial literacy (Fernandes et al., 2014), is contested. While Miller et al. (2014) suggested that financial education positively impacts some specific behavior, including savings and record keeping, they nonetheless caution that there remains substantial disagreement over the efficacy of financial education. More recent meta-analyses (Kaiser et al., 2020; Kaiser and Menkhoff, 2017) have provided more optimistic results, arguing that "financial education has a strong positive impact on financial literacy with an effect size [standardized mean difference or Hedges' *g* [(Hedges, 1981)] of 0.26 [95% CI 0.18, 0.34]" (Kaiser and Menkhoff, 2017).[3] Kaiser et al. (2020) reported that when analysis is restricted to randomized control trials, effects are "at least three times as large as the weighted average effect" reported by Fernandes et al. (2014). Better control for program effectiveness in addition to the inclusion of more recent studies,[4] is most likely responsible for this discrepancy in results.

Kaiser and Menkhoff (2017) also highlighted the heterogeneity in the effectiveness of interventions, notably for "low income clients" which they attributed to "these individuals are more difficult to educate" (Kaiser and Menkhoff, 2017). Alternatively, heterogeneity is consistent with the prediction that "not everyone benefits from greater financial sophistication, some consumers will rationally remain financially ignorant" (Lusardi et al., 2017). That is, acquisition of financial literacy is a choice.

While financial literacy can be accumulated, it can also depreciate due to obsolescence or decay (Lusardi and Mitchell, 2014). Fernandes et al. (2014) estimated significant decay rates suggesting that while effect sizes from interventions increase with length of intervention, 24 months after delivery, no financial literacy or financial behavior is significantly associated with a financial education intervention, irrespective of instruction length. This is a considerably higher decay rate than the 6% per annum depreciation rate assumed by Lusardi et al. (2017). Kaiser and Menkhoff (2017) suggested that some of the inconsistency in evidence of intervention is due to the time at which the measurement is taken (e.g. if it is delayed). As discussed in Section 2, no evidence is available for decay rates of university education interventions over long time-periods.[5] The available evidence on effect sizes within this context pertains to immediately post intervention, but we provide much needed evidence of effect sizes three years after the intervention.

University level personal finance education courses are generally elective options for students, and this is the case for the unit assessed in the current paper. The *Managing Your Personal Finances* unit was developed at The University of Western Australia in 2013 as an elective unit option. Students can select the unit in partial fulfilment of a course requirement that they select four of their twenty-four units from areas beyond their degree major. The course credit for the semester-length unit is equal to that for other units in degree majors or for other general elective options. The in-person class contact requirements of a two-hour lecture and a one-hour tutorial are also comparable to those for other units. For most students, the commitment would comprise one-quarter of a normal semester load.

Because it is an elective, it is important to carefully consider possible self-selection effects when assessing outcomes attributable to unit enrolment. To identify outcomes, we compare those who enrol in the unit with a control group drawn from students who are otherwise eligible to enrol, but who did not. As discussed further in Section 3.1, a comparison of observable characteristics at baseline among both groups in terms of financial literacy and financial experiences, supports the view that those who enrol in the unit are largely comparable to their peers who do not. Participant dropout is a significant difficulty in following students over time. Dropout associated with either the outcomes of interest or the covariates, is problematic when identifying effects associated with financial education. Again, a comparison of observable characteristics, discussed in Section 3.2, supports the view that survey response rates are not systematically different across variables of interest. This suggests that the missing data can plausibly be described as missing at random. Given this, we estimate likelihood-based mixed effects models with individual random effects that use all available data, to estimate unbiased results (Vittinghoff et al., 2010).

A preliminary review of the sample examined in this paper guided our expectations (Gerrans and Heaney, 2019). Three-years after unit completion, we expected to find persistence in the positive effects in students': objective and subjective assessments of their financial literacy; in their propensity to perform positive financial behaviors; and in their use of independent sources of financial information. We also expected to find decay in effects, but given the education opportunity is provided when students are first

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[2] Fernandes et al. (2014) provided the manipulated (i.e. interventions) versus measured (i.e. cross-sectional) classification.

[3] Hedges' *g*, or corrected Cohen's *d* (Cohen, 1988) effect size, is interpreted as per Cohen's *d* but applies a correction to the sample estimate of the population effect size (Lakens, 2013). Calculation of the effect size in the current paper is discussed in Section 4.1.

[4] For example, Kaiser et al. (2020) compare 64 randomized control trials versus 13 in Fernandes et al. (2014).

[5] Kaiser et al.'s (2020) meta-analysis has a median time of 26 weeks between treatment and outcome measurement.

encountering financial decisions, i.e. just-in-time (Fernandes et al., 2014), we did not expect the rate of decay to be severe. We also expected heterogeneity in effects and explored differences by gender given that while lower financial literacy is documented more among women than men (Lusardi and Mitchell, 2008), "less is understood about what factors contribute to these differences" (Fonseca et al., 2012).

To preview our results, we find more robust persistence in objective and subjective financial literacy than in positive financial behaviors. Three-years after the unit, small to medium effect sizes remained with objective and subjective financial literacy. We found evidence of heterogeneity in outcomes, with greatest gains in financial literacy isolated to female students in a number of domains. We identified the difficulty students had in sustaining positive financial behavior effects over the medium term, which supports the view that explicit financial behavior change needs to be addressed directly (Kaiser and Menkhoff, 2017).

After considering a conceptual framework and reviewing the evidence of financial intervention effects within a university context in Section Two, in the third section we provide a description of the student context and description of the scales and instruments used in the analysis. The fourth section presents the method and analysis before the final section concludes with a discussion of findings, caveats, and suggestions for future work.

2. Literature and conceptual framework

2.1. Empirical evidence

A large, empirical body of literature demonstrates a significant, positive relationship between financial literacy and financial behavior, including: more effective general debt choices (Lusardi and Tufano, 2015; Robb et al., 2015) and student debt choices (Artavanis and Karra, 2020); financial market participation (Grohmann, 2018; Li et al., 2020; van Rooij et al., 2011); retirement planning (Bucher-Koenen and Lusardi, 2011; Niu et al., 2020; van Rooij et al., 2012); and insurance coverage (Bateman et al., 2020; Lin et al., 2017). The positive relationship extends to outcomes that include financial welfare (e.g. Jiang et al., 2020) and income inequality (Lusardi et al., 2017).

A review of this literature is not the objective of this paper, but a number of meta-analyses now document evidence on financial education outcomes (Fernandes et al., 2014; Hastings et al., 2013; Kaiser et al., 2020; Kaiser and Menkhoff, 2017; Lusardi and Mitchell, 2014; Miller et al., 2014; Stolper and Walter, 2017). The literature differs in findings as to the magnitude of (positive) effects isolated to financial literacy and as to whether those findings are influenced by the inclusion or otherwise, of omitted variables such as other skills (e.g. numeracy, see Lusardi, 2012), cognitive ability (Campbell, 2006), and traits (e.g. future time perspective and propensity to plan, see Fernandes et al., 2014).

A further empirical problem lies in establishing causal direction; that is, in accounting for behavior leading to higher knowledge in addition to improved knowledge leading to behavior change. Fernandes et al. (2014) and Lusardi and Mitchell (2014) review attempts to account for endogeneity, whether due to omitted variables or simultaneity, and reach different conclusions. The former foundon found "smaller effects for studies using instrumental variables than for OLS studies lacking those controls" (Fernandes et al., 2014); whereas the latter suggested, "it seems clear that the non-instrumented estimates of financial literacy may underestimate the true effect" (Lusardi and Mitchell, 2014).

The role of financial education interventions in improving financial literacy or financial outcomes and the extent to which effects persist, is contested in the literature. While the previously noted meta-analyses provide useful evidence of the efficacy of interventions, university level interventions are largely absent from any analysis. For example, the comprehensive review by Kaiser and Menkhoff (2017) includes only nine studies of university students with only seven of them evaluating interventions. Amagir et al. (2018) reviewed education programs for children and adolescents and included four university interventions that were not in Kaiser and Menkhoff (2017). Kaiser et al. (2020) included three studies at undergraduate level in their sample of randomized control interventions.

2.2. Conceptual model

Before reviewing these university level studies, we consider a conceptual model for why university level financial education interventions might be expected to provide positive outcomes. While the apparent arguments made for financial education appear "straightforward" or make "common sense" according to (Stolper and Walter, 2017), others urge tempering expectations (Campbell, 2006) or argue actively against it (Willis, 2008).

Cunha and Heckman (2007) built a conceptual model of skill formation in which a multistage technology governs the process of skill (ability) development. The staged process allows for self-productivity. That is, later stages build on the skills developed in earlier stages, and dynamic complementarity, where productivity at later stages is higher given earlier skill formation. Stages are also expected to be uneven in terms of their productivity. Some stages are classified as "sensitive" stages in that they are more productive than others and "if one stage alone is effective in producing a skill" it is a "critical stage" (Cunha and Heckman, 2007).

Given that university study is a period for establishing autonomy (Arnett, 2015) and seeking independence (Shim et al., 2010), it is also a sensitive stage with personal finance topics foregrounded. Arguments for "just-in-time" financial education interventions (Fernandes et al., 2014) complement the concept of sensitive and critical stages of personal development which suggest it is best to provide education when it is most directly needed and able to be applied. However, "just-in-time" tends to refer to more specific times/ events such as when buying a house; purchasing insurance when, for example, buying a car; or when it is necessary to nominate a retirement savings plan (when joining an employer). The counter arguments to this narrow framing are that it is often too late to

educate oneself in financial literacy when an event requiring it arises, and that key financial decisions are not at point-of-sale (e.g. saving early, Lusardi, 2015). Here, in the context of university financial education, just-in-time is used in the broader sense of being a sensitive stage, or period, rather than event specific.

2.3. Australian context

University is not the first-time young adults will have had some form of financial education. Socialisation models (Shim et al., 2010; Shim et al., 2009) emphasise the roles of parents, peers and formal school education in the development of young people's financial knowledge and attitudes. In the Australian context, the National Curriculum for Schools introduced financial literacy in 2014, though "introduced" both overstates and understates the teaching of financial literacy in Australian schools. In terms of the former, financial literacy was taught prior to inclusion in the National Curriculum. The Australian Securities and Investments Commission (2003) provided a stocktake of financial education in Australian schools in the early 2000s and noted that while the term "financial literacy" did not have much currency among teachers, financial literacy was in fact being taught in several learning areas. Further, the report noted that given education is a state responsibility, and notwithstanding the national curriculum, choices remain at state, school, and teacher level as to what and how, teaching is delivered to meet required learning outcomes.

There is, therefore, significant variation expected in student experience. Such variation is further compounded by heterogeneity in teacher understanding, confidence, and ability to identify appropriate professional development (Sawatzki and Sullivan, 2017). This heterogeneity dampens our expectation of being able to parse evidence of dynamic complementarity in the absence of detailed, information about students' prior financial education experience. However, we do expect that those with prior exposure to financial education to have higher financial literacy, on average.[6]

2.4. University financial education evidence

Evidence of the impact of university level financial education courses is conveyed via a mixture of cross-sectional surveys, which rely on an indication of prior study at university level (e.g. Lyons, 2008; Mandell, 2009; Xiao et al., 2012), or via evaluations at a specific university (e.g. Maurer and Lee, 2011; Peng et al., 2007; Skimmyhorn et al., 2016). Other studies have used national surveys (e.g. Wagner and Walstad, 2019 use the U.S. National Financial Capability Study (NFCS)) which have the advantage of large sample size but at the expense of the researcher being unable to control for heterogeneity in course quality, topics taught, and, importantly, baseline information of participants. Control for baseline differences, exploring heterogeneity in effects across different outcomes, and exploring heterogeneity in effects by participant characteristics (i.e. gender) are discussed in the current paper.

While evaluations of an individual intervention have the advantage of providing specific course detail, much of the (positive) evidence is limited to short-term evaluations. For example, evidence using evaluation periods of: two-days (Gross, 2005); a 90 min seminar (Borden et al., 2008); two lectures (Bowen and Jones, 2006); and a 2.5 h course (Yetter and Suiter, 2015). While Brugiavini et al. (2015) also have conducted a short-term evaluation of low-intensity finance literacy education (i.e. of a 20-min presentation) it is notable in that it is a randomized-control experiment using both a field and a laboratory setting. The current paper provides much-needed evidence over longer (3-year) time periods.

Other studies have demonstrated the benefits of financial literacy education using different delivery mechanisms such as peer (student) delivered presentations (DeLaune et al., 2010; Maurer and Lee, 2011), college counselling clinics (Fox et al., 2013), and comparisons between a "rule of thumb" based teaching approach and a "principles based approach" (Skimmyhorn et al., 2016). Skimmyhorn et al. (2016) suggested the relationship between financial knowledge and self-efficacy "warrants further attention" given their result that improvements in self-efficacy outstrip knowledge improvements and we explore this in the current paper.

3. Survey and student profile

The introduction provided an overview of the financial literacy unit that is the focus of the paper. Supplementary Appendix I provides further detail of unit structure and coverage and additional detail can be found in Gerrans and Heaney (2019). To identify the effects associated with unit enrolment, a control group was recruited from the broader student population who were eligible to enrol but chose not to enrol. The total sample of students consisted of 865 students (332 Unit, 533 in the Control group) who completed a pre-course (baseline) survey.

A previous comparison of administrative data for those enrolled in the unit with their peers suggested no difference in terms of domestic and international student ratio and academic performance using entry scores, although males and those from science majors were more likely to enrol (Gerrans and Heaney, 2019). Table 1 presents a further comparison of additional observable characteristics between the Unit and Control group at baseline, which were collected from the survey. The comparison suggests the two were broadly comparable groups. There were no significant differences in living arrangements (Live at Home) or in whether the students had previously studied an area of finance. There were also no significant differences in financial experience (or in Work and Study arrangements, Superannuation, Income, or Debt). Differences were restricted to distribution of assets (a smaller proportion of the Unit sample had Personal effects only), age (Unit sample was approximately one year younger), and the Unit sample was more likely

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[6] Measures of prior education are self-report. Given financial literacy is not taught as a separate subject, respondents may not consider they have received financial education if it was taught in social science, for example.

Table 1
Respondent summary at baseline.

	Unit	Control	Unit - Control	p-value difference
Age (years)	19.623	20.910	−1.287	<0.001
Female (proportion)	0.452	0.640	0.208	<0.001
Live at home (proportion)	0.714	0.719	−0.005	0.881
International students (proportion)	0.087	0.081	0.006	0.730
Have superannuation (proportion)	0.614	0.632	−0.018	−0.599
Work and study (proportion)				
No work, studying fulltime	0.328	0.343	−0.015	0.205
< 10 h work per week plus study	0.250	0.283	−0.033	
10–20 h work per week plus study	0.319	0.291	0.028	
> 20 h work per week plus study	0.102	0.083	0.019	
Income (proportion)				
< $10,000	0.663	0.685	−0.022	0.128
$10,000 - $24,999	0.271	0.221	0.05	
≥ $25,000	0.066	0.094	−0.028	
Assets (proportion)				
Personal effects only	0.220	0.323	−0.103	0.007
< $5000	0.313	0.244	0.069	
$5000–$19,999	0.343	0.306	0.037	
≥ $20,000	0.123	0.128	−0.005	
Debt (proportion)				
No Debt	0.792	0.765	0.027	0.640
< $5000	0.111	0.137	−0.026	
$5000–$19,999	0.066	0.060	0.006	
≥ $20,000	0.030	0.038	−0.008	
Previous study (proportion)				
No	0.554	0.492	0.062	0.154
Completed at high school	0.142	0.195	−0.053	
Completed at high school and since	0.145	0.159	−0.014	
Completed only since high school	0.160	0.154	0.006	
Major (proportion)				
Commerce Single/Double	0.075	0.137	−0.062	<0.001
Arts/Humanities Single or Double	0.139	0.221	−0.082	
Sciences Single or Double	0.675	0.375	0.3	
Arts/Humanities and Science	0.012	0.028	−0.016	
Sciences and Arts/Humanities	0.015	0.081	−0.066	
Commerce & Humanities	0.051	0.081	−0.03	
Commerce & Science	0.033	0.077	−0.044	
Science	0.012	0.028	−0.016	
Science & Humanities	0.015	0.081	−0.066	
Ethnicity (proportion)				
Other	0.096	0.099	−0.003	0.001
Asian	0.154	0.244	−0.09	
British/European	0.072	0.107	−0.035	
Aust/NZ	0.678	0.550	0.128	
Sample size				
Total – Baseline (pre)	332	533		
2013 - Post	304	212		
Follow-up 2014	84	199		
Follow-up 2015	48	138		
Follow-up 2016	75	147		
Total Observations	843	1229		

Australian than Asian ethnicity. As discussed further in Section 4, to control for these differences in observable characteristics, we estimated multilevel mixed-effects models which included all observations at baseline as well as individual random effects. In addition, we estimated all regressions separately by gender, given the profile differences.

Students were subsequently invited to complete a survey in November 2014, 2015, and 2016. The later surveys were supplemented with new scales, but the same set of knowledge, attitudes, and behavior were included and formed the basis of the analysis in this paper. The 2014 and 2015 survey participants were incentivised with the promise of entry into prize draws for one of three $50 gift vouchers on completion of the survey. The 2016 survey was incentivised with a $25 voucher for a completed survey. Students enrolled in the unit were originally given unit credit of 1% for survey completion, as data was used for teaching purposes. All survey instruments were approved by The University of Western Australia Ethics Committee.

3.1. Population and sample profile

While the context of being in transition makes undergraduate students a compelling population, they remain "an admittedly special population" (Brugiavini et al., 2015). Being a university student places an individual in a higher education performance level than the

general population. For example, only 39% of Australian 25–29 year-olds have a bachelor degree (Australian Bureau of Statistics, 2019). In the Australian system, students more commonly remain with the family during studies. In the current sample, 71% of the pooled unit and control samples lived at home at baseline and 67% did so three years later. A majority had a non-education debt (79% of the unit, 77% of the control, at baseline) which reduced to 64% (unit) and 61% (control), three years later. This is comparable to other evidence which suggests that the proportion of Australian undergraduate students with a loan is between 25 and 30%, depending on whether they are full or part-time students (Bexley et al., 2013).

The previous literature on the subject has focussed on U.S. studies. In the U.S. 56% of students have a credit card (Cellini and Darolia, 2016), whereas in Australia the proportion with a credit card is between nine and 19%, depending on whether a full-time or part-time student (Bexley et al., 2013). Student education (government) debt in Australia[7] is structured with income-contingent, no-interest loans repaid via the tax-system with balances indexed to inflation. On average, a larger proportion of Australian students than American students accumulate a debt, though the amount is lower than for their U.S. counterparts.[8]

While classified as full-time students, most have part-time employment (67% Unit, 66% Control) with the most common number of hours being 10–20 h per week (48% Unit, 44% Control). Given the compulsory nature of the Australian retirement savings system, a majority of students (61% Unit, 63% Control), by virtue of their employment, have a retirement savings account.[9] In summary, the pattern above suggests the average student is, as expected, very much in transition, experiencing some independence and beginning to experience the opportunities and responsibilities of financial independence.

3.2. Key survey measures

3.2.1. Financial literacy - Objective
Two measures of financial literacy were estimated across each wave. Supplementary Appendix II contains the full set of questions. A "Basic" measure comprised four questions: the impact of compounding (compounding); inflation (inflation); time value of money (TVM); and an inflation/money illusion (money illusion). These questions were derived from those previously developed (Lusardi and Mitchell, 2009; van Rooij et al., 2011) and utilised widely in national surveys such as the US Health and Retirement Study and the De Nederlandsche Bank Household Survey. The questions comprising an "Advanced" scale are also from Lusardi and Mitchell (2009); (van Rooij et al., 2011) and ask about: the comparative risk between shares and bonds (risky assets); returns over the long term (returns assets); volatility over the long term (volatility); and the result of diversification (diversification). A third scale was administered, from the post-survey onwards, based on the scale developed by Fernandes et al. (2014) (FLN). This scale incorporates each of the questions in the Advanced scale plus questions related to investing and managed funds (four), bonds (one), diversification (one), retirement savings (one), and questions examining debt (credit card, mortgage). Because this scale was not administered in the pre-survey, no isolated benefit can be assessed pre-post, but a comparison of the average levels of each group can still be made.

3.2.2. Subjective financial literacy and financial behaviors
Self-assessments of components of financial literacy were evaluated given evidence that actual (objective) and perceived (subjective) financial literacy are both influential in predicting financial behavior (Allgood and Walstad, 2016; Bellofatto et al., 2018). Students were asked to rate (Extremely Poor (1) to Extremely Good (7)), two dimensions of knowledge: what is required to invest in financial assets (Investing Knowledge); and what is required to invest in Superannuation (Super Knowledge)? A measure of financial self-efficacy was included by asking students to rate their "Ability to make day to day financial decisions", using the same Extremely Poor (1) to Extremely Good (7) scale (Self-Efficacy). In addition, students rated how satisfied (Very Dissatisfied (1) to Very Satisfied (7)) they were with their ability to manage their personal finances (Satisfaction).

3.2.3. Information sources
Decisions about new financial products and services require consumers to access new information. Sources of information vary in level of independence and accuracy and consumers attaching more importance to the impartial and accurate sources than to those that are not, is key to improved financial decision making. Participants were asked to rate a set of questions, based on OECD-INFE (2011), between Not at All Important (1) and Extremely Important (5)) about a variety of information sources when they made financial decisions. The question asked about the following sources: Unsolicited (3-items, mail, email, company brochure); Advertisements (2-tems, newspaper, TV); Independent/Authority (3-items, consumer regulator, govt. agency, financial counsellor); and Family/Friends (2-items, family, friends).

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[7] Domestic students apply for "Commonwealth supported places" and the cost is split between the federal government and the student. The student component varies by course and can be paid with a HECS-HELP loan repaid via the Australian Taxation Office. The threshold for beginning repayment was AUD$45,881 in 2019/20, when 4% of taxable income was levied as a repayment but increases to 8% for an income of $107,214. For a summary of the rules, see https://www.studyassist.gov.au/paying-back-your-loan/loan-repayment

[8] In Australia (U.S.) 79 (62) percent of undergraduates have a student loan debt with an average annual amount of US$4017 (US$4330). Both are lower than the UK (92%, average maintenance loan of US$5612, tuition loan of US$10,824) (OECD 2017a).

[9] Superannuation is the retirement savings product similar to the US 401(k) with the key difference being employer contributions are mandatory contributions for employees of 9.5% of wages, given monthly earnings of at least $450.

3.2.4. Additional correlates of financial literacy

Previous studies have identified a range of financial literacy correlates that were collected as controls. This study included self-assessed maths ability, given the demonstrated relationship between numeracy and financial literacy (Lusardi, 2012). It also included measures for the Big-Five personality domains: Agreeableness; Extraversion; Openness; Neuroticism and Conscientiousness (John et al., 1991). Future time perspective is significant in explaining behavior (Andre et al., 2018) and along with the risk tolerance scale developed by Jacobs-Lawson and Hershey (2005), was included and expected to be positively associated with financial literacy. The survey also collected indicators for whether the student had completed prior studies in a related subject (accounting, finance, business) at high-school, since, or both, to allow for self-productivity (Cunha and Heckman, 2007). Finally, the survey included a question on the extent to which financial matters were discussed at home, to capture parent socialisation effects, and expected to be positively related to the student's financial literacy (Shim et al., 2010).

3.3. Pre, post-surveys and respondent attrition

Tracking students over a three-year span produces attrition in respondents that can compromise the analysis, particularly here, where the composition of the unit and control groups may change and affect results both within and between groups. A comparison of survey numbers across the five surveys is presented at the bottom of Table 1. A total of 2072 surveys was completed over the period by 865 students. A multinomial logistic regression examined which characteristics predicted those who completed one, two, three, four, or five surveys. Table 2 presents the estimated relative risk ratios for completing each of two to five surveys relative to completing one survey. In addition to the summary variables previously reported (indicators for unit enrolment, female, study major, whether studied accounting/finance/business previously), a range of other student related variables was included: an indicator for whether the baseline financial literacy was higher than the median score of two; self-rated maths ability; the Big-Five personality scores; future time perspective; and an indicator for whether financial matters were discussed at home.

In terms of completing the immediate follow up survey, the risk of students not completing it was higher for those in the Control group than for those in the Unit group, although this did not hold true for the 2016 follow-up survey. Those scoring higher on Conscientiousness were more likely, and those scoring higher on Extraversion less likely, to complete more of the follow-up surveys. Beyond this the significant differences in survey completion appear isolated to a particular number of surveys rather than spread in a consistent pattern. There is a suggestion that those with higher Basic scores complete more surveys than others, though this is only significant for two or four surveys relative to one survey completed. Each of the estimations reported below control for each of the above variables to minimise potential bias from systematic differences in propensity to complete surveys.

4. Method and analysis

4.1. Estimators and controls

We estimate multilevel mixed-effects model with individual random effects to reduce the impact of non-random selection and attrition (Vittinghoff et al., 2010). Regressions include predictors for: demographics (Female, Age, Ethnicity); financial demographics (Assets, Income, Debt); study characteristics (Major, and Previous Study – High school, High School and Since); the Big 5 personality traits; risk attitude (Risk Tolerance); future time perspective (FTP); a measure of numeracy using a self-assessment of maths ability (Maths Ability); and exposure to financial education socialisation via discussion of finances at home (Discussed). Indicators for enrolment in the Unit (Control as the base) and for survey wave (Post-2013, 1-Year 2014, 2-Year 2015, 3-Year 2016) are also included.

The interactions of the indicator for Unit enrolment and survey wave are the variables of most interest as they isolate the difference in outcomes for those enrolled in the Unit at the completion of the unit (Post-2013*Unit), and at each of the survey time points (1-Year 2014*Unit, 2-Year 2015*Unit, 3-Year 2016*Unit). As the FLN financial literacy measure was only added in 2014, there is no ability to analyse pre-post unit completion effects.

Estimated results cover a range of domains (e.g., objective financial knowledge, subjective financial knowledge, financial behavior) as well a range of scales within domains (e.g. basic, and advanced objective knowledge). To facilitate comparisons of results across domains and scales, we estimate effect sizes (Cohen, 1988) calculated as standardized mean differences using the pooled standard deviation of scores at baseline (Feingold, 2013).[10] We adopt Cohen's (1988) benchmarks of 0.2 as a small effect, 0.5 a medium effect, and 0.8 a strong effect.[11]

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[10] We calculate the sample effect size (d_s) as $\dfrac{\beta_{U-C}}{\sqrt{\frac{(n_U-1)sd_U^2+(n_C-1)sd_C^2}{(n_U+n_C-2)}}}$, where n_U and n_C are the sample sizes of the unit and control groups, and sd_U and sd_C are the respective standard deviations at baseline.

[11] We note Kraft's (2020) argument that "we need to update our expectations" of education program effects generally as the "vast majority of education interventions fail to produce effects that would even be judged as small by Cohen's standards". Specifically, there is a need to consider the empirical evidence for effect sizes within comparable domains (e.g. here, financial literacy, financial behavior). Notwithstanding, we retain the more conservative benchmarks.

Table 2
Likelihood of completing different number of surveys.

Surveys	Two	Three	Four	Five
Unit	9.004***	4.378***	7.917***	2.077
	(3.693)	(2.006)	(4.348)	(1.669)
Fin. Literacy Basic	1.725*	1.491	2.8808***	1.586
	(0.484)	(0.442)	(1.097)	(0.609)
Unit*Fin. Lit. Basic	1.343	1.334	1.153	1.647
	(0.713)	(0.772)	(0.762)	(1.306)
Fin. Literacy Advanced	0.593*	0.682	1.468	1.065
	(0.163)	(0.211)	(0.473)	(0.398)
Unit*Fin. Lit. Advanced	1.693	1.838	0.428	2.587
	(0.892)	(1.068)	(0.270)	(1.997)
Female	1.101	1.065	1.315	1.039
	(0.263)	(0.287)	(0.426)	(0.369)
Major (base Sciences): Commerce Single/Double	1.386	0.840	0.472	0.514
	(0.487)	(0.352)	(0.262)	(0.355)
Arts/Humanities Single or Double	0.816	1.044	0.876	1.050
	(0.246)	(0.334)	(0.336)	(0.492)
Arts/Humanities and Science	1.706	1.470	3.298	6.544**
	(1.376)	(1.4095)	(2.948)	(5.806)
Sciences and Arts/Humanities	0.938	1.212	1.008	2.859*
	(0.444)	(0.608)	(0.583)	(1.560)
Commerce & Humanities	1.468	1.324	1.345	2.509
	(0.596)	(0.627)	(0.756)	(1.466)
Commerce & Science	0.781	0.504	1.625	1.427
	(0.334)	(0.287)	(0.797)	(0.931)
Age	0.967	1.010	0.998	1.012
	(0.025)	(0.025)	(0.024)	(0.024)
Ethnicity (base Aust/NZ): Other	0.557*	0.592	1.406	1.493
	(0.190)	(0.230)	(0.574)	(0.760)
Asian	0.643*	0.715	0.799	0.843
	(0.170)	(0.207)	(0.304)	(0.338)
British/European	1.166	0.971	0.835	0.335
	(0.375)	(0.369)	(0.356)	(0.241)
Income	1.130	0.619**	1.014	1.140
	(0.194)	(0.135)	(0.234)	(0.286)
Assets	0.978	1.130	0.988	0.964
	(0.115)	(0.135)	(0.133)	(0.166)
Debt	0.940	0.872	0.899	0.805
	(0.135)	(0.145)	(0.177)	(0.164)
Math's ability	1.017	1.022	1.080	1.296*
	(0.095)	(0.108)	(0.118)	(0.192)
Personality (BFI): Extraversion	0.856	0.581***	0.698*	0.649*
	(0.124)	(0.099)	(0.129)	(0.152)
Agreeableness	0.781	0.834	1.374	0.611**
	(0.145)	(0.180)	(0.334)	(0.146)
Conscientiousness	1.734***	1.671**	2.503***	2.994***
	(0.308)	(0.344)	(0.584)	(0.861)
Neuroticism	1.075	1.341	1.416*	1.301
	(0.180)	(0.255)	(0.295)	(0.291)
Openness	0.927	1.148	1.079	0.956
	(0.177)	(0.252)	(0.285)	(0.319)
Risk Tolerance	0.887	0.807*	0.768**	0.625***
	(0.091)	(0.096)	(0.101)	(0.105)
FTP	1.036	1.108	0.957	0.967
	(0.093)	(0.114)	(0.117)	(0.129)
Previous study (base none):				
High School	1.099	1.157	0.430**	1.008
	(0.326)	(0.356)	(0.180)	(0.424)
High School & Since	1.304	0.980	0.489	0.733
	(0.410)	(0.363)	(0.213)	(0.360)
Since High School	1.536	1.289	1.499	1.312
	(0.459)	(0.434)	(0.528)	(0.569)
Discussed	1.049	0.947	1.127	1.132
	(0.110)	(0.104)	(0.147)	(0.160)
LL	−1117.6			
Chi-2	312.5			
df	124			
Observations	865			
Nagelkerke Pseudo R-Squared	0.343			

This table presents the estimated odds ratio for completing up to five surveys relative to only completing one survey only. Relative risk ratios are reported with robust standard errors reported in parentheses clustered by individual and significance is reported by *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.2. Multiple hypothesis tests

Multiple comparisons to evaluate financial education intervention effects are estimated in this paper which creates a potential problem that significant "coefficients may emerge simply by chance, even if there are no treatment effects" (Anderson, 2008). Gelman et al. (2012) argued that "the problem is not multiple testing but rather insufficient modeling of the relationship between the corresponding parameters of the model" and suggested that a multi-level model can "make comparisons appropriately more conservative". While modeling multiple group comparisons (e.g. survey year) may be reasonable in a multi-level model, multiple outcomes present a "conceptual jump", mitigated to the extent that the outcomes are measuring similar phenomena (Gelman et al., 2012).

As noted, multilevel models are used to estimate the results presented below, which may reduce concerns of multiple tests. However, not all aspects are modelled (e.g. gender is considered via separate regressions). Hence, adjustments for false discovery rates (FDRs) are also investigated to establish robustness of results. FDRs seek to control the expected proportion of errors in false rejections (Benjamini and Hochberg, 1995).[12] FDR has greater power compared to the familywise error rate (FWER) and in the current context "the probability of *any* error [from FWER] is unnecessarily stringent" (italics added) (Benjamini and Hochberg, 1995). We accept the trade-off of a "small number of type I errors in exchange for greater power than FWER control" (Anderson, 2008). Adjustment does not materially change the estimated financial education unit effects for financial literacy components, core financial behavior, or positive financial behavior. Unadjusted results retain significance when adjusted except in a handful of cases where marginally significant unadjusted *p*-values lose significance when adjusted. In the main text, the unadjusted *p*-values and robust standard errors are presented, and in Appendix III of the Supplementary file, both unadjusted and adjusted p-values are presented.

4.3. Results

4.3.1. Objective financial literacy

We first examine objective financial literacy (Basic and Advanced) and investigate the effect of unit enrolment and the extent to which effects are sustained. There is a medium correlation between the two measures (0.34) indicating similar, but different, constructs. We follow van Rooij et al. (2011) and construct a financial literacy index using the iterated principal component method to extract a Bartlett factor score. Whereas van Rooij et al. (2011) used indicators for "don't know" responses, we score "don't know" responses as the probability of a correct answer excluding the "don't know" choice, which von Gaudecker (2015) noted can be considered as equivalent to the approach of van Rooij et al. (2011).

To estimate the factor score, there is a choice as to which sample to estimate a factor structure with given repeated observations. Moeller (1998) sounded a note of caution about the pitfalls of pooling and standardization in longitudinal studies, given standardizing across individuals within each time period produces a zero mean at both times, even though we may expect an increase over time for the Unit group. Alternatively, when standardizing across Pre and Post-assessments, "the information about the time-point-specific relative rank-order gets mixed with the mean-level change" (Moeller, 1998). Given an expectation of change over time, we report results using the latter construction and pool across surveys. To demonstrate robustness of results, we present estimations using the first construction and results using a raw score, which is the number of correct answers, in supplementary materials (Appendix III, Table 3b).

Table 3 presents the estimated results for financial literacy (objective knowledge): Basic, Advanced, and FLN. Results for the full sample are presented in columns one, four, and seven, with results by gender in the remaining columns. The results for controls are as per Gerrans and Heaney (2019). Noteworthy is the persistent negative female coefficient. Maths Ability, Assets, and Age are each significant and positive. Those with previous studies (High School and since) had higher scores, consistent with self-productivity. That is, "skills acquired in one period persist into future periods" (Cunha and Heckman, 2007). Similarly, Discussed, is significant but only for the Advanced score. Students of Asian ethnicity scored lower on the Advanced and FLN measures.

The Unit and survey wave interaction estimates indicate a spike in scores for the Unit group at the end of semester (Post-2013*Unit) for both the Basic and Advanced scales. The effect size for the Basic measure of 0.34 (95% confidence levels (CIs) 0.18–0.51) exceeds the benchmark for a small effect immediately at the end of the unit. The effect size for Advanced is medium: 0.54 (CIs 0.36–0.72). To investigate "dynamic complementarity" (Cunha and Heckman, 2007) the model was re-estimated with an indicator for prior study added to the Unit and Survey interaction. The estimate is not significant (not tabulated), not supporting a magnified gain for those with prior studies.

Over successive waves, effect sizes remain small for Basic and small to medium for Advanced. The suggestion of a decay effect after the 2013-post survey is not supported by a joint test of the interaction coefficients, which fails to reject equality (Basic: χ^2 (3df) 5.13, *p*-value 0.163; Advanced χ^2 (3df) 4.85, p-value 0.183). Equality tests of various pairings of coefficients (e.g. Post*Unit vs 2016*Unit) suggest only one significant difference: between Post-2013 and 2014 for Basic (χ^2 3.93, p-value 0.047). All other comparisons are not significant. While a pre-post comparison is not possible for the FLN measure (it was not collected at baseline), one year after unit completion, those enrolled in the Unit had higher scores, though this is only significant for females. Recall that there were no significant differences between groups at baseline for the other two scores.

The coefficients for each survey wave (Post-2013 to Year 3–2016) are positive and generally significant, suggesting a drift upwards for those in the Control group. This could reflect a learning effect from the survey instrument itself or reflect an accumulation of

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[12] We use the Stata *qqvalue* program (Newsom, 2010) and Simes (1986) -Benjamini-Hochberg (1995) method (using option *Simes*).

Table 3
Financial literacy and unit completion.

	Basic Overall	Basic Female	Basic Male	Advanced Overall	Advanced Female	Advanced Male	FLN Overall	FLN Female	FLN Male
Post-2013	0.211***	0.233**	0.160	0.135*	0.030	0.332**			
	(0.078)	(0.105)	(0.104)	(0.082)	(0.102)	(0.131)			
1-Year 2014	0.413***	0.440***	0.346***	0.201**	0.062	0.461***			
	(0.084)	(0.111)	(0.116)	(0.091)	(0.120)	(0.124)			
2-Year 2015	0.177*	0.112	0.297**	0.379***	0.285**	0.537***	0.036	0.036	0.038
	(0.100)	(0.135)	(0.123)	(0.099)	(0.128)	(0.139)	(0.068)	(0.094)	(0.079)
3-Year 2016	0.412***	0.495***	0.237**	0.247**	0.178	0.361**	0.037	0.092	−0.102
	(0.094)	(0.127)	(0.094)	(0.106)	(0.135)	(0.160)	(0.073)	(0.099)	(0.083)
Unit	−0.024	0.010	−0.095	0.002	0.022	0.023	0.189	0.300**	0.097
	(0.102)	(0.146)	(0.144)	(0.101)	(0.139)	(0.149)	(0.116)	(0.153)	(0.181)
Post-2013*Unit	0.504***	0.921***	0.164	0.742***	0.991***	0.418**			
	(0.123)	(0.178)	(0.159)	(0.124)	(0.172)	(0.183)			
1-Year 2014*Unit	0.175	0.253	0.159	0.485***	0.684***	0.154			
	(0.168)	(0.254)	(0.190)	(0.162)	(0.223)	(0.233)			
2-Year 2015*Unit	0.471***	0.601**	0.274	0.408**	0.475*	0.269			
	(0.169)	(0.287)	(0.184)	(0.165)	(0.255)	(0.200)			
3-Year 2016*Unit	0.300**	0.514**	0.131	0.580***	0.605***	0.464**			
	(0.151)	(0.216)	(0.187)	(0.144)	(0.203)	(0.199)			
Female	−0.317***			−0.166**			−0.496***		
	(0.085)			(0.077)			(0.114)		
Age	0.027***	0.024***	0.032***	0.027***	0.023***	0.037***	0.036***	0.034***	0.051***
	(0.006)	(0.007)	(0.010)	(0.006)	(0.008)	(0.010)	(0.007)	(0.009)	(0.013)
Income	0.050	0.037	0.029	−0.053	−0.049	−0.077	0.003	−0.024	0.020
	(0.050)	(0.072)	(0.066)	(0.048)	(0.065)	(0.067)	(0.049)	(0.068)	(0.060)
Assets	0.111***	0.089*	0.146***	0.089***	0.050	0.136***	0.104**	0.067	0.128*
	(0.036)	(0.046)	(0.055)	(0.033)	(0.042)	(0.050)	(0.041)	(0.048)	(0.074)
Debt	−0.021	−0.021	−0.022	−0.058*	−0.005	−0.105**	−0.048	−0.006	−0.098**
	(0.035)	(0.050)	(0.048)	(0.034)	(0.045)	(0.051)	(0.033)	(0.044)	(0.046)
Math's Ability	0.165***	0.169***	0.133**	0.092***	0.050	0.129**	0.181***	0.183***	0.070
	(0.033)	(0.040)	(0.056)	(0.032)	(0.036)	(0.061)	(0.049)	(0.058)	(0.099)
BFI: Extraversion	−0.160***	−0.184**	−0.125	−0.131***	−0.075	−0.226***	−0.173***	−0.220***	−0.137
	(0.053)	(0.072)	(0.077)	(0.044)	(0.057)	(0.069)	(0.061)	(0.075)	(0.102)
Agreeableness	−0.158**	−0.243***	−0.046	−0.110*	−0.214***	0.014	−0.199**	−0.311***	0.091
	(0.072)	(0.091)	(0.111)	(0.060)	(0.075)	(0.093)	(0.086)	(0.100)	(0.161)
Conscientiousness	0.028	−0.020	0.101	0.100*	0.119	0.093	−0.089	−0.038	−0.208
	(0.062)	(0.083)	(0.093)	(0.057)	(0.074)	(0.090)	(0.075)	(0.094)	(0.131)
Neuroticism	−0.174***	−0.200**	−0.142	−0.076	−0.136*	−0.024	−0.195***	−0.251***	−0.128
	(0.064)	(0.090)	(0.088)	(0.053)	(0.070)	(0.080)	(0.075)	(0.091)	(0.130)
Openness	0.089	0.132	0.021	−0.081	−0.046	−0.161*	0.038	0.039	0.036
	(0.078)	(0.103)	(0.117)	(0.066)	(0.086)	(0.096)	(0.094)	(0.118)	(0.135)
Risk Tolerance	−0.040	−0.103**	0.026	0.047*	0.038	0.052	0.039	−0.025	0.118***
	(0.031)	(0.045)	(0.042)	(0.027)	(0.037)	(0.040)	(0.037)	(0.055)	(0.042)
FTP	−0.024	−0.069	0.052	0.083***	0.041	0.138***	0.047	0.048	0.016
	(0.035)	(0.044)	(0.056)	(0.031)	(0.039)	(0.047)	(0.047)	(0.055)	(0.074)
Prior study: School	0.174*	0.287**	0.055	0.224**	0.310**	0.156	0.187	0.178	0.217
(base none)	(0.102)	(0.142)	(0.146)	(0.093)	(0.128)	(0.133)	(0.120)	(0.156)	(0.196)
School & Since	0.073	0.302*	−0.253	0.144	0.329**	−0.041	0.097	0.084	0.137
	(0.113)	(0.157)	(0.162)	(0.113)	(0.151)	(0.159)	(0.147)	(0.194)	(0.255)
Since School	0.124	0.232	0.017	0.116	0.231*	−0.022	0.085	0.075	0.158
	(0.104)	(0.154)	(0.140)	(0.090)	(0.138)	(0.115)	(0.128)	(0.185)	(0.196)
Discussed	0.023	0.028	0.020	0.112***	0.117**	0.112**	0.046	0.009	0.128*
	(0.039)	(0.052)	(0.058)	(0.035)	(0.046)	(0.050)	(0.047)	(0.062)	(0.076)
Constant	−0.635	−0.052	−1.643*	−1.365***	−0.735	−2.144**	−0.356	0.058	−1.264
	(0.580)	(0.786)	(0.887)	(0.499)	(0.621)	(0.863)	(0.768)	(0.939)	(1.338)
Additional controls	Study area, Ethnicity								
Var. (individual)	0.672***	0.713***	0.571***	0.413***	0.447***	0.301***	0.603***	0.574***	0.633
Var. (residual)	0.984	1.100	0.750**	1.014	1.054	0.934	0.371***	0.450***	0.182***
-2LL	−3313.9	−2011.2	−1259.3	−3236.1	−1932.7	−1278.2	−896.6	−590.3	−282.2
Chi-2	376.6	247.9	131.5	471.7	263.0	217.9	319.7	111.9	120.9
df	35	34	34	35	34	34	29	28	28
Obs	2072	1220	852	2072	1220	852	691	439	252
Individuals	865	502	363	865	502	363	407	256	151

This table presents estimates from a multilevel mixed-effects linear regression for three financial literacy indices. The index is constructed following von Gaudecker (2015) where factor scores are estimated pooled across the surveys. For each measure an overall estimate is presented along with an estimation by gender. The results of the same regression using raw scores and the factor scores pooled within surveys are reported in Supplementary Table S3b. Standard errors in parentheses are clustered by individual. Significance indicated by *** p < 0.01, ** p < 0.05, * p < 0.1.

financial literacy through students' experience over the period. The estimations by gender suggest a pattern of larger improvements for females for Basic; whereas for Advanced, the larger improvements are for males in the Control group. The significant Unit completion effects (i.e. interaction coefficients) are in addition to these increasing scores.

Results by gender also suggest that the significant effects for Basic in the Unit group are isolated to females as estimated coefficients for males are not significant. However, only the Post*Unit coefficient is significantly larger for females. Equality of coefficients for females across surveys is rejected at the 95% confidence level, but not at 90%. Paired tests of interaction coefficients suggest a decay in effects with the 1-year and 3-year estimates lower than the Post-2013*Unit estimate. For the Advanced scale, the Post-2013*Unit and 2014*Unit coefficients are also significantly higher (*p*-values 0.022, 0.095) for females. There is no decay evidence for males, but again there is for females. Each subsequent survey has lower interaction coefficients than for Post-2013*Unit, with Advanced for males an exception.

4.3.2. Under and overconfidence in objective measures

Students were asked how many questions they thought they had answered correctly at the end of each set of Basic and Advanced questions. This number minus the number of correct answers can be interpreted as a measure of confidence. A positive (negative) value can indicate an over (under) confident student. That is, they think they have more (less) correct responses than is true. Those with the correct number of correct responses are classified as "calibrated". Willis (2013) suggested that providing information in such courses may lead to the "illusion of knowledge" and over-confidence.[13] Such an outcome from course completion would be problematic, given evidence linking overconfidence and outcomes such as problematic debt use (Kim et al., 2020; Robb et al., 2015). A multinomial logit model was estimated with the three confidence groups as the outcome and the same set of variables as previously included, plus two additional variables. The first variable is the financial literacy score and the second is the number of questions answered with a "don't know" response, as it is assumed that a student answering the number of correct answers would exclude questions they answered with a 'don't know'.

We present the results in Table 4 for the Advanced set of questions. Results based on the Basic set of questions (not tabulated) were substantively the same. Students enrolled in the unit can be characterized as calibrated. One exception, where the likelihood of over-confidence increases (2013-Post), is not associated with the Unit group. Those enrolled in the unit do not have a higher likelihood of over-estimating the number of correct answers. Where the coefficients are significant, the likelihood is reduced for being either under or overconfident relative to having the correct number (calibrated).

4.3.3. Financial literacy subjective assessments

The effects from enrolment in the financial literacy unit on the four subjective ratings for the financial literacy components were generally stronger. The subjective ratings for knowledge (Investing, Superannuation (retirement savings)) had a comparable correlation (0.65) to the two general subjective ratings (0.60 correlation between Self-Efficacy and Satisfaction). Correlation between the subjective knowledge and the general subjective ratings was lower, between 0.38 and 0.48. The correlation between the objective knowledge measures in the previous section and the subjective ratings were lower again. The Advanced and Investing pairing had the highest correlation (0.37) with Basic and Superannuation Knowledge the lowest (0.13).

Each subjective measure was used as an outcome of unit enrolment, with the same set of predictors as for the objective outcomes. Table 5 presents odds ratios from a multilevel mixed-effects ordered logistic model regression, with separate estimations by gender presented in Table 6. The results have similarities to the objective outcome results, with some notable differences. Female students had lower odds of rating themselves higher on each measure, though this is not significant for Self-Efficacy. Ratings increased with assets, income, higher conscientiousness, FTP, previous studies, mathematics ability, and those reporting family discussions (Discussed). Lower ratings were more likely for higher levels of debt and scores on neuroticism. For each subjective measure, the odds of higher ratings significantly increased with objective financial literacy, suggesting self-ratings have a basis in objective financial literacy.[14]

Those enrolled in the unit group were more likely to have higher self-assessments immediately after the unit. The odds-ratio for the Post-2013*Unit interaction was significantly larger than the one for each subjective rating. Chen et al. (2010) classified odds-ratios exceeding 1.68, 3.47, and 6.71 as threshold equivalents to small, medium, and large Cohen effect sizes, respectively. The effect size for Self-Efficacy immediately after the unit was small and remained so in 2016. A test for the equality of the odds-ratios for each survey and unit interaction was not rejected (χ^2 2.21, *p*-value 0.531). The odds-ratios for three other self-assessments each had a large effect size immediately after the unit, with ratios in subsequent years suggesting decay in subjective ratings. Nonetheless, effect sizes remained medium in magnitude three years after unit completion. A comparison of Post and 2016 odds-ratios for those in the unit group did not reject equality for Satisfaction Managing Finances (χ^2 0.15, p-value 0.697) but the likelihood of higher ratings in 2016 was significantly lower than the 2013-Post for Investing (χ^2 7.09, p-value 0.008) and Superannuation knowledge (χ^2 14.92, p-value <0.01). This extends the results of Skimmyhorn et al. (2016) who reported similar boosts to self-assessed knowledge and self-efficacy immediately post course.

The higher subjective ratings for those enrolled in the unit appeared more robust for females. At least a small to medium effect size

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[13] More specifically overconfidence as overestimation or "thinking that you are better than you really are". Prims and Moore (2017, p.29) identified this as one of three types of overconfidence. The other two are overplacement ("the exaggerated belief that you are better than others"), and overprecision ("the excessive faith that you know the truth").

[14] The financial literacy measure included in the estimation was the residual or unexplained financial literacy from a regression of the Advanced measure and the remaining set of predictors used in the objective regressions.

Table 4
Confidence and unit completion.

	Under	Over
	Base: Calibrated	
Survey: Post-2013	0.472***	3.424***
	(0.107)	(0.733)
1-Year 2014	0.954	0.835
	(0.182)	(0.221)
2-Year 2015	0.735	0.381**
	(0.162)	(0.147)
3-Year 2016	0.631**	0.710
	(0.144)	(0.223)
Unit	1.143	1.084
	(0.200)	(0.251)
Post-2013*Unit	0.345***	1.480
	(0.123)	(0.456)
1-Year 2014*Unit	0.503**	0.909
	(0.172)	(0.416)
2-Year 2015*Unit	0.653	0.931
	(0.268)	(0.621)
3-Year 2016*Unit	0.578	0.954
	(0.217)	(0.482)
Don't knows	0.523***	0.637***
	(0.031)	(0.048)
Female	2.182***	0.849
	(0.351)	(0.126)
Age	0.973**	0.987
	(0.014)	(0.013)
Income	1.299***	0.927
	(0.129)	(0.107)
Assets	0.852**	0.941
	(0.055)	(0.070)
Debt	1.011	1.079
	(0.068)	(0.091)
Math's Ability	0.863***	1.132*
	(0.049)	(0.078)
Personality type (BFI):		
Extraversion	0.850*	0.923
	(0.078)	(0.089)
Agreeableness	1.134	1.112
	(0.129)	(0.138)
Conscientiousness	1.097	0.922
	(0.128)	(0.104)
Neuroticism	1.074	0.937
	(0.108)	(0.102)
Openness	0.865	1.186
	(0.099)	(0.158)
Risk Tolerance	0.905*	0.944
	(0.054)	(0.061)
FTP	1.029	0.996
	(0.058)	(0.056)
Previous study (base none):		
High School	1.007	0.958
	(0.168)	(0.188)
High School & Since	1.043	1.302
	(0.224)	(0.280)
Since High School	1.074	0.854
	(0.192)	(0.160)
Discussed	0.915	1.066
	(0.064)	(0.075)
Additional controls	Study area, Ethnicity	
-2LL	−1829.2	
Obs	2072	
Individuals	865	

This table presents results from a multilevel mixed-effects multinomial logit regression for a measure of under and over-confidence. The relative risk ratios of underestimating or overestimating the number of Advanced questions correct are presented relative to the group who are calibrated in that they correctly identified how many questions they had correct. Standard errors in parentheses are clustered by individual with significance reported by *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 5
Self-assessments of financial literacy components.

	Self-efficacy	Investing knowledge	Superannuation knowledge	Satisfaction managing finances
Survey: Post-2013	1.133	1.000	1.442***	1.370**
	(0.195)	(0.144)	(0.196)	(0.208)
1-Year 2014	1.069	1.098	1.701***	1.627***
	(0.188)	(0.177)	(0.258)	(0.280)
2-Year 2015	0.817	0.650**	1.134	1.217
	(0.173)	(0.129)	(0.231)	(0.247)
3-Year 2016	1.078	0.804	1.683***	1.380
	(0.240)	(0.164)	(0.331)	(0.312)
Unit	0.474***	0.589***	0.486***	0.243***
	(0.094)	(0.108)	(0.086)	(0.047)
Post-2013*Unit	1.684**	12.471***	11.649***	6.783***
	(0.392)	(2.848)	(2.531)	(1.487)
1-Year 2014*Unit	2.552***	9.779***	6.617***	6.755***
	(0.716)	(2.808)	(1.949)	(2.190)
2-Year 2015*Unit	1.829	4.118***	5.183***	9.077***
	(0.784)	(1.568)	(1.961)	(3.483)
3-Year 2016*Unit	1.960*	5.006***	2.895***	4.523***
	(0.703)	(1.810)	(1.074)	(1.797)
Fin. Literacy Residual	1.165**	1.393***	1.271***	1.172**
	(0.089)	(0.082)	(0.072)	(0.074)
Female	0.761	0.485***	0.749*	0.666**
	(0.139)	(0.077)	(0.111)	(0.117)
Age	1.014	1.055***	1.069***	1.022
	(0.015)	(0.016)	(0.013)	(0.016)
Income	1.471***	1.060	1.425***	1.186
	(0.161)	(0.103)	(0.136)	(0.129)
Assets	1.329***	1.394***	1.355***	1.288***
	(0.098)	(0.090)	(0.089)	(0.093)
Debt	0.819***	0.917	0.915	0.785***
	(0.061)	(0.067)	(0.065)	(0.070)
Math's Ability	2.011***	1.379***	1.237***	1.492***
	(0.142)	(0.088)	(0.071)	(0.093)
Personality: Extraversion	0.994	0.945	1.043	0.835
	(0.111)	(0.094)	(0.093)	(0.094)
Agreeableness	0.881	0.896	0.917	0.965
	(0.121)	(0.117)	(0.109)	(0.133)
Conscientiousness	2.008***	1.263*	1.295**	2.037***
	(0.270)	(0.158)	(0.152)	(0.265)
Neuroticism	0.948	0.757***	0.857	0.709***
	(0.116)	(0.081)	(0.091)	(0.084)
Openness	1.024	1.076	1.102	0.894
	(0.158)	(0.142)	(0.137)	(0.135)
Risk Tolerance	1.057	1.670***	1.482***	1.098
	(0.072)	(0.105)	(0.087)	(0.076)
FTP	1.434***	1.294***	1.255***	1.324***
	(0.097)	(0.082)	(0.076)	(0.090)
Previous study: High School	1.163	2.625***	1.496**	1.402
(base none):	(0.242)	(0.500)	(0.261)	(0.303)
High School & Since	1.771***	4.054***	1.170	1.678**
	(0.384)	(0.975)	(0.239)	(0.409)
Since High School	1.205	1.829***	1.359*	1.219
	(0.252)	(0.343)	(0.239)	(0.251)
Discussed	1.322***	1.601***	1.345***	1.529***
	(0.105)	(0.120)	(0.094)	(0.116)
Additional controls	Study area, Ethnicity			
Variance (individual)	11.025***	8.257***	4.675***	12.132***
-2LL	−2586.6	−3204.7	−3279.5	−2907.4
Chi-2 (df 36)	397.7	643.1	639.7	438.8
Obs	2072	2072	2072	2072
Individuals	865	865	865	865

This table presents odds ratios from a multilevel mixed-effects ordered logistic regression for measures of subjective financial literacy. Outcomes in first three columns are measured on the scale: Extremely Poor (1) to Extremely Good (7). The last scale is Very Dissatisfied (1) to Very Satisfied (7). Objective financial literacy is the residual from a regression of the Advanced scale and the variables in Table 3. Standard errors in parentheses are clustered by individual. Significance reported by *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 6
Self-Assessments of financial literacy components by gender.

	Self-efficacy		Investing knowledge		Superannuation knowledge		Satisfaction managing finances	
	Female	Male	Female	Male	Female	Male	Female	Male
Post-2013	1.259	0.937	1.009	0.949	1.337	1.608**	1.217	1.832**
	(0.270)	(0.281)	(0.186)	(0.218)	(0.237)	(0.341)	(0.228)	(0.489)
1-Year 2014	0.941	1.332	1.039	1.163	1.564**	1.937***	1.730***	1.458
	(0.196)	(0.457)	(0.202)	(0.349)	(0.316)	(0.473)	(0.366)	(0.436)
2-Year 2015	1.152	0.369***	0.548**	0.854	1.053	1.239	1.122	1.345
	(0.308)	(0.127)	(0.143)	(0.267)	(0.280)	(0.408)	(0.280)	(0.476)
3-Year 2016	0.978	1.224	0.671	1.074	1.319	2.725***	1.028	2.610**
	(0.278)	(0.454)	(0.167)	(0.378)	(0.322)	(0.905)	(0.266)	(1.176)
Unit	0.375***	0.576*	0.588**	0.617*	0.453***	0.531**	0.190***	0.390***
	(0.099)	(0.186)	(0.145)	(0.175)	(0.110)	(0.141)	(0.049)	(0.118)
Post-2013*Unit	1.962**	1.647	14.265***	12.409***	14.999***	9.685***	7.868***	4.823***
	(0.631)	(0.610)	(4.701)	(4.138)	(4.538)	(3.027)	(2.330)	(1.652)
1-Year 2014*Unit	4.181***	1.312	15.901***	5.331***	10.063***	4.419***	7.588***	6.110***
	(1.521)	(0.622)	(5.861)	(2.404)	(4.082)	(1.893)	(3.307)	(3.036)
2-Year 2015*Unit	3.226**	1.755	6.011***	2.546	6.360***	4.830***	11.378***	7.086***
	(1.816)	(1.128)	(3.016)	(1.573)	(3.465)	(2.740)	(5.497)	(4.750)
3-Year 2016*Unit	3.270***	1.077	5.730***	4.096**	4.422***	1.783	8.702***	1.595
	(1.476)	(0.650)	(2.561)	(2.439)	(2.254)	(0.974)	(4.501)	(1.059)
Fin.Lit. Residual	1.156	1.196	1.334***	1.468***	1.254***	1.292**	1.186**	1.107
	(0.106)	(0.177)	(0.099)	(0.147)	(0.086)	(0.132)	(0.097)	(0.119)
Age	1.007	1.050*	1.056***	1.065**	1.068***	1.081***	1.021	1.035
	(0.019)	(0.026)	(0.019)	(0.029)	(0.017)	(0.023)	(0.016)	(0.036)
Income	1.565***	1.261	1.165	0.840	1.440***	1.378**	1.250	1.065
	(0.206)	(0.233)	(0.152)	(0.122)	(0.189)	(0.189)	(0.178)	(0.184)
Assets	1.196*	1.578***	1.353***	1.513***	1.454***	1.184*	1.208**	1.423***
	(0.112)	(0.199)	(0.105)	(0.177)	(0.130)	(0.112)	(0.108)	(0.185)
Debt	0.888	0.707***	0.902	0.959	0.942	0.860	0.892	0.639***
	(0.091)	(0.082)	(0.084)	(0.114)	(0.090)	(0.094)	(0.099)	(0.095)
Math's Ability	1.904***	2.308***	1.326***	1.448***	1.230***	1.192*	1.366***	1.762***
	(0.158)	(0.290)	(0.106)	(0.154)	(0.089)	(0.119)	(0.099)	(0.190)
Extraversion	0.889	1.202	0.928	1.022	0.995	1.057	0.861	0.800
	(0.128)	(0.207)	(0.117)	(0.160)	(0.119)	(0.143)	(0.117)	(0.154)
Agreeableness	0.813	0.901	0.906	0.897	0.921	0.910	1.052	0.831
	(0.146)	(0.192)	(0.148)	(0.190)	(0.149)	(0.151)	(0.190)	(0.182)
Conscientiousness	2.006***	2.223***	1.122	1.607**	1.257	1.399**	1.969***	2.261***
	(0.354)	(0.452)	(0.189)	(0.318)	(0.204)	(0.236)	(0.314)	(0.496)
Neuroticism	0.963	0.898	0.670***	0.924	0.718**	1.066	0.685***	0.727
	(0.150)	(0.177)	(0.093)	(0.159)	(0.102)	(0.167)	(0.094)	(0.154)
Openness	1.218	0.665	1.137	0.842	1.210	0.840	0.948	0.731
	(0.237)	(0.166)	(0.188)	(0.185)	(0.200)	(0.166)	(0.172)	(0.184)
Risk Tolerance	1.070	1.040	1.680***	1.642***	1.542***	1.403***	1.078	1.152
	(0.096)	(0.108)	(0.148)	(0.151)	(0.117)	(0.134)	(0.094)	(0.136)
FTP	1.418***	1.421***	1.287***	1.286**	1.254***	1.284***	1.222**	1.498***
	(0.117)	(0.164)	(0.098)	(0.146)	(0.096)	(0.124)	(0.098)	(0.187)
Previous study: High School	1.148	1.219	3.389***	2.026**	1.839**	1.130	1.546	1.182
(base none):	(0.325)	(0.386)	(0.855)	(0.575)	(0.441)	(0.296)	(0.446)	(0.395)
High School & Since	1.362	2.422***	4.016***	4.580***	0.956	1.609*	1.604	1.648
	(0.448)	(0.752)	(1.270)	(1.704)	(0.298)	(0.448)	(0.502)	(0.632)
Since High School	1.300	1.292	1.891**	2.017***	1.457	1.358	1.060	1.327
	(0.371)	(0.409)	(0.540)	(0.490)	(0.379)	(0.316)	(0.325)	(0.384)
Discussed	1.393***	1.201	1.701***	1.483***	1.402***	1.276**	1.598***	1.448***
	(0.143)	(0.137)	(0.167)	(0.168)	(0.122)	(0.142)	(0.157)	(0.170)
Controls	Study area, Ethnicity							
Variance (ind.)	11.681***	7.822***	8.335***	6.584***	6.055***	2.859***	9.457***	12.750***
-2LL	−1524.2	−1025.7	−1869.6	−1311.8	−1898.1	−1357.8	−1745.8	−1134.2
Chi-2 (df 35)	263.0	204.5	326.2	334.8	362.1	311.8	254.0	241.3
Obs	1220	852	1220	852	1220	852	1220	852
Individuals	502	363	502	363	502	363	502	363

This table presents odds-ratios for re-estimates of Table 5 by gender. Outcomes in first six columns use a seven-point scale: Extremely Poor (1) to Extremely Good (7). The last two columns use: Very Dissatisfied (1) to Very Satisfied (7). Objective financial literacy is the residual from the Advanced scale regression in Table 3. Standard errors in parentheses are clustered by individual. Significance reported by *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

across ratings and surveys was estimated for female students enrolled in the unit. Immediately after unit completion, the effect size for Self-Efficacy was small for female students and equality of odds over subsequent surveys was not rejected (χ^2 3.76, p-value 0.289) but for males the effects were not significant. For Satisfaction Managing Finances, the large effect size for female students immediately

after the unit was maintained for subsequent surveys and a test of equality of effects was not rejected (χ^2 0.61, p-value 0.895). For males, a medium effect size immediately after the unit, had become non-significant by 2016.

For both Superannuation and Investing knowledge, effect sizes were large immediately after the unit, but subsequent odds-ratios were significantly reduced. A test for equality of Superannuation knowledge was rejected for females (χ^2 8.20, p-value 0.042) and for males (χ^2 3.95, p-value 0.047). The 2016 odds-ratio was significantly lower than the 2013-Post for females in the unit (χ^2 6.32, p-value 0.012) and males (χ^2 9.73, p-value <0.01). The same pattern was estimated for Investing, where both females enrolled in the unit (χ^2 4.31, p-value 0.038 respectively) and males (χ^2 3.95, p-value 0.047 respectively) maintained higher subjective ratings three-years later, though the effect size reduced from strong to medium.

4.3.4. The basis of changes in subjective assessments

Skimmyhorn et al. (2016) suggested that the "relationship between financial knowledge and self-efficacy warrants further attention". Accordingly, we followed Brugiavini et al. (2015) and classified changes in the two objective and four subjective measures as either: increased, unchanged, or decreased, and examined the relationship between the pre- vs. post-surveys and, separately, between the pre-survey vs. the 2016-survey (3-year) assessments. Cross tabulating each objective and subjective score produced nine permutations. For example, both measures could increase between surveys or one increase while the other decreased, etc. To match the classifications presented in Table 4, and to permit a more meaningful set of outcomes, the nine groups were consolidated into three. The calibrated group had changes in objective and subjective scores in the same direction. That is, both positive, both negative, or both unchanged. The second group was characterized as overconfident, as the subjective score increased but the objective score did not; or, in the case where the objective score decreased, the subjective score was unchanged. The third group, the under-confident group, had objective scores increase, but the subjective score not; or alternatively, where the objective score was unchanged, the subjective score decreased. These cross-tabulations are presented in Figs. S1 to S4 in Supplementary Appendix IV.

Comparing the size of these groups, the calibrated group was the largest of all, except for one of the 16 cross-tabulations, which varied from a high of 59% (for changes in Advanced and Superannuation compared between pre and post surveys) to a low of 41% (for changes in Basic and Satisfaction between pre and 3-year surveys). The pairing of Advanced and Self-Efficacy for the pre- and 3-year surveys was the exception as the largest group was the underconfident group. The evidence did not support the view that those completing education interventions developed a misplaced or unfounded source of confidence (Willis, 2013). In none of the pairings was the over-confident group the dominant one. Notwithstanding, there was a reasonably-sized overconfident group who do not appear to have a good reason for changes in subjective scores. The highest proportion classified as overconfident was 43%, when comparing Basic and Superannuation pre and post scores, and the lowest was 17%, when comparing the Advanced and Self-Efficacy pre and post scores. It may be that the objective measures did not adequately capture the driver of the subjective measures, or vice-versa.

When comparing the pre vs. 3-year and pre vs. post scores, most commonly the over-confident group was smaller, suggesting overconfidence, to the extent it was evident had faded. It appeared that the "underconfident" group tended to be the offsetting group, which became larger in all but one case. It could be that the confidence gained from unit completion fades, notwithstanding retained objective knowledge, or that objective knowledge raises awareness of difficulties in financial decisions. Further work is needed to investigate this.

As a final investigation of confidence, the three groups identified were combined with a fourth group, namely those who did not complete the post-survey. A multinomial regression was estimated with a set of predictors that had been proposed as relating to (over) confidence. These included indicators for unit enrolment, previous studies, gender, the big-five personality traits, and baseline objective and subjective scores. The tabulations are provided in the Supplementary Appendix IV, Tables S1 (pre to post) and S2 (pre to three year). In none of the cases was the likelihood of being in the over-confident group higher for those enrolled in the unit than for those who were not. There was more support for a lower likelihood for this group relative to peers. There was also no evidence that overconfidence was more likely for those who had undertaken previous studies. In sum, the assessment that overconfidence "appears significantly more prevalent than underconfidence" (Willis, 2013) was not supported by the data.

4.3.5. Financial behavior

Students were asked whether they had exhibited four types of positive financial behavior over the previous 6-months (3-months for the Post-survey): 1) tracked spending (Track); 2) established a financial goal (Goal); established a budget or spending plan (Budget); and 4) ensured/checked they had enough set aside for an emergency (Emergency). A multilevel mixed effects regression was estimated and results are reported in the supplemental materials, Appendix III, Table III.8a. Notwithstanding the high baseline probabilities for behavior, a clear increase in the odds for each type of behavior was estimated for those in the Unit group immediately post unit completion. However, the increase was not maintained. Behavior remained at relatively high levels, but the gap between the groups had dissipated by 2016. In the estimations within gender (not tabulated), the results were the same.[15]

A further set of questions focussed on an additional set of positive financial behavior proposed by OECD-INFE (2011). Respondents were asked to respond to the following questions: "Before buying something I carefully consider whether I can afford it" (Afford); "I pay my bills on time" (Bills); "I keep a close personal watch on my financial affairs" (Watch); and "Before committing to a financial

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[15] The pattern of a boost post unit followed by a decay was investigated further by the level of conscientiousness and future time perspectives. The sample was split by median conscientiousness score and re-estimated and separately split by median FTP and re-estimated (not tabulated). In each case the same pattern was observed.

decision I consult independent sources of information/advice" (Consult). They were asked to indicate how often each statement was applicable to their behavior using the scale of Never (1) to Always (5). A multilevel mixed effects regression was estimated and the results are reported in supplemental materials, Appendix III, Table III.8b. Higher odds were estimated for three positive types of behavior (Afford, Watch, Consult) for those in the Unit group immediately post-course. The effect sizes were below a small effect magnitude. Ceiling effects are again suggested due to high baseline scores for behavior. The estimated odds for Afford were sustained through to 2016 but were not significant. Similarly, the weak and small effects for Watch and Consult were no longer significant in 2016.

4.3.6. Information sources

It was expected that more independent and impartial information sources would increase in importance relative to the other sources for those enrolled in the unit. Table 7 presents estimated regression results of importance scores for the four sources of information discussed in Section 3.2. The results suggest differences in importance by student characteristics. For example, more available but less authoritative (e.g. family and friends, or unsolicited sources) were rated higher for female students but lower for older students and those with previous studies (since high school). Financial socialisation (i.e. having discussed finances at home) was associated with higher ratings for more independent sources (e.g. MoneySmart).

A significant increase in the importance of impartial (Authority) sources of information for those enrolled in the unit was evident immediately on completion of the unit. The effect size comfortably exceeded the small threshold (0.44, CIs 0.26–0.62) and remained significant in 2016 (0.26, CIs −0.03-0.56). Importance attached to informal and less reliable sources (e.g. family, friends and unsolicited scores) were significantly lower at unit completion, though the effect size did not reach the minimum threshold (0.18, Cis 0.01–0.34). An interesting feature of the results in Table 7 was a common decline in the importance of these informal and less reliable sources over time for all students. Students reflected a more general expectation as they progressed through their studies – a more discerning mind for information sources.

5. Conclusions

This paper has provided much needed longitudinal evidence for the impact of a personal finance unit delivered to university undergraduates. We built on Gerrans and Heaney (2019) by considering assessments three years after students had completed a semester-long unit, relative to otherwise comparable peers who did not complete the unit. We investigated both actual (objective) and perceived (subjective) financial literacy, given evidence that they are both influential in financial behavior (Allgood and Walstad, 2016).

The results identify sustained improvements in objective financial literacy three years after students completed the unit. The estimated effect sizes (Cohen, 1988) for objective measures are small for a Basic scale and medium for an Advanced scale. There is some evidence of a decay, but this is not robust and where identified, it appears the decay is attributable to a marginal increase in scores for those in the Control group rather than a decrease in the Unit group's scores. There is no evidence of average decay rates comparable to those reported in the meta-analysis of Fernandes et al. (2014).

In terms of subjective measures, positive effects from being enrolled in the unit were evident immediately after the unit, and they ranged from small effect sizes for self-efficacy to strong effects for two knowledge items and an overall satisfaction for managing finances assessment. As with the objective measures, there was some decay, for example strong effects became medium. On closer analysis, the positive results for self-efficacy and satisfaction appeared isolated to female students. For the two knowledge items, results were more robust for female students, whereas evidence of positive effects for males was isolated to investing knowledge, which declined from medium to small over three years. We found evidence of higher performance for those with prior studies (self-productivity) but no evidence of an additional impact for the group who had also completed the unit (dynamic complementarity).

No evidence was found linking completion of the unit with overconfidence. Subjective assessments appeared broadly grounded in objective financial literacy. However, a significant minority of students reported an improvement in subjective ratings which was not linked to change in objective assessments, suggesting that overconfidence fades over time. This may indeed be misplaced confidence, but future research is needed to explore the experience of students and the role of factors such as change in objective financial literacy in the dynamics of subjective assessments.

Evidence for behavioral change was not robust over time. While positive financial behavior was significantly higher for those in the Unit group immediately after the unit was completed, in many cases these small effects dissipated. The exception was for a small, sustained positive effect for checking the affordability of purchases, which remained three years after the unit. In some cases, the lack of an effect could, in part, be attributed to a ceiling effect because the frequency of behavior was very high at baseline. However, the pattern of a short-term but not sustained boost to positive performance was more common. This supports the argument that "changes in financial behavior should also be addressed directly" (Kaiser and Menkhoff, 2017) rather than solely relying on indirect effects via financial literacy.

In addition to financial literacy, personality traits, preferences, social norms, and values are expected to be reflected in financial behavior as they were here. Explicit behavior change was not a nominated outcome of the unit. The offering of the unit implicitly reflects a view of financial literacy "as an endogenous choice variable akin to human capital investment" (Lusardi et al., 2017). Those designing courses choose whether they emphasise positive or normative approaches when it comes to financial behavior and choose how explicit they are about this. Future research could usefully investigate this emphasis and its role on subsequent student behavior.

Identifying the importance of independent sources of information is important to help decision making. The importance attached to these sources was significantly higher (small effect size) immediately after the unit and maintained three years after. A notable pattern

Table 7
Information sources, confidence in information search and unit completion.

	Ads	Authority	Fam. Friends	Unsolicited	Info Search
Survey: Post-2013	−0.128**	−0.031	−0.099**	−0.067*	
	(0.053)	(0.038)	(0.045)	(0.037)	
1-Year 2014	−0.335***	−0.009	−0.139***	−0.423***	
	(0.056)	(0.045)	(0.044)	(0.037)	
2-Year 2015	−0.329***	−0.088	−0.145**	−0.156**	0.017
	(0.068)	(0.058)	(0.067)	(0.079)	(0.067)
3-Year 2016	−0.354***	0.033	−0.170***	−0.613***	0.017
	(0.069)	(0.057)	(0.064)	(0.052)	(0.074)
Unit	−0.046	0.116***	−0.081	−0.037	0.296***
	(0.054)	(0.041)	(0.053)	(0.044)	(0.095)
Post-2013*Unit	0.089	0.253***	−0.122*	−0.103*	
	(0.072)	(0.052)	(0.063)	(0.053)	
1-Year 2014*Unit	0.199**	0.236***	0.083	0.017	
	(0.097)	(0.069)	(0.076)	(0.074)	
2-Year 2015*Unit	−0.010	−0.058	−0.138	−0.076	
	(0.128)	(0.123)	(0.115)	(0.150)	
3-Year 2016*Unit	0.078	0.150*	−0.021	−0.031	
	(0.121)	(0.087)	(0.102)	(0.084)	
Fin. Literacy Residual	−0.044**	0.051***	0.007	0.025	0.081*
	(0.021)	(0.016)	(0.018)	(0.016)	(0.045)
Female	0.063	0.048	0.139***	0.147***	−0.193**
	(0.047)	(0.036)	(0.045)	(0.038)	(0.098)
Age	0.003	0.004	−0.010***	−0.013***	0.005
	(0.006)	(0.003)	(0.004)	(0.003)	(0.007)
Income	−0.013	0.035	0.041	−0.023	0.038
	(0.032)	(0.026)	(0.031)	(0.026)	(0.054)
Assets	−0.054***	−0.018	0.005	−0.036**	0.124***
	(0.020)	(0.017)	(0.019)	(0.017)	(0.039)
Debt	−0.012	−0.009	0.021	0.003	−0.078**
	(0.025)	(0.019)	(0.021)	(0.021)	(0.033)
Math's Ability	−0.011	0.017	−0.012	0.027*	0.090**
	(0.018)	(0.015)	(0.017)	(0.016)	(0.044)
Personality: Extraversion	0.071**	−0.039*	0.101***	0.049**	−0.005
	(0.031)	(0.022)	(0.028)	(0.024)	(0.058)
Agreeableness	0.101***	0.076**	0.085**	0.140***	−0.194**
	(0.038)	(0.032)	(0.036)	(0.031)	(0.077)
Conscientiousness	−0.009	0.008	−0.072**	0.021	0.078
	(0.039)	(0.029)	(0.033)	(0.031)	(0.071)
Neuroticism	0.036	−0.005	0.058*	0.023	−0.177***
	(0.033)	(0.025)	(0.033)	(0.027)	(0.064)
Openness	−0.030	−0.015	−0.004	−0.078**	0.219***
	(0.044)	(0.033)	(0.036)	(0.030)	(0.075)
Risk Tolerance	0.038*	−0.004	−0.007	0.051***	0.248***
	(0.021)	(0.015)	(0.016)	(0.016)	(0.037)
FTP	0.069***	0.075***	0.042**	0.038***	0.124***
	(0.019)	(0.016)	(0.018)	(0.015)	(0.039)
Previous study: High School	0.027	0.041	−0.080	0.009	0.162
(base none):	(0.060)	(0.044)	(0.054)	(0.049)	(0.120)
High School & Since	0.067	0.004	−0.009	−0.046	0.212
	(0.063)	(0.049)	(0.062)	(0.055)	(0.146)
Since High School	−0.039	0.045	−0.135**	−0.095**	−0.105
	(0.058)	(0.042)	(0.062)	(0.048)	(0.109)
Discussed	−0.013	0.048***	0.040*	−0.006	0.074*
	(0.022)	(0.016)	(0.021)	(0.018)	(0.045)
Constant	1.747***	2.794***	2.973***	2.462***	0.697
	(0.297)	(0.246)	(0.295)	(0.268)	(0.587)
Additional controls	Study area, Ethnicity				
Variance (individual)	0.149***	0.096***	0.170***	0.103***	0.368***
Variance (residual)	0.396***	0.232***	0.294***	0.264***	0.400***
-2LL	−2245.9	−1712.2	−2029.6	−1835.1	−282.1
Chi-2 (d.f. 36, 30 for final column)	208.3	201.8	192.8	616.8	175.5
Obs	2072	2072	2072	2072	691
Individuals	865	865	865	865	407

This table present estimations from a multilevel mixed-effects linear regression. Five groups of information sources are based on their assessed level of importance (Not at all Important (1) to Extremely Important (5)) using ten different information items. The measure of financial literacy used is the residual from a regression of the raw Advanced scale and the set of variables as described in Table 3. Standard errors in parentheses are clustered by individual. Significance is reported by *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

for all students was a decline in the importance attached to family/friends and unsolicited sources.

Finally, it is important to highlight those characteristics identified as significant in explaining both the cognitive aspects of financial literacy and the possible predispositions to positive financial behavior, not typically targeted by education interventions, but amenable to change. For both objective and subjective measures, maths ability is a significant predictor. The significance of cognitive skills in explaining economic outcomes has previously been documented (e.g. Lusardi, 2012; Smith et al., 2010). Choosing to focus on improving these skills in the unit is balanced against a desire to reach students in majors where maths ability is not a requirement or a chosen focus of students. Improvements in subjective assessments (self-efficacy) provide further support for calls for "academics and policy makers to design programs to increase perceived financial self-efficacy" given the self-efficacy and financial well-being relationship (Netemeyer et al., 2018).

The estimations of behavior change also highlight the role of several personality traits in reporting behavior. For example, those scoring higher on the conscientiousness trait, or those with a stronger future time perspective, had higher likelihood of engaging in positive behaviors with longer term payoffs. Research suggests that it is possible to modify these characteristics. For traits, see Hudson and Fraley (2015) and for a review of future time perspective, see Mello (2019). Future research can usefully investigate whether interventions that seek to modify these characteristics can be integrated with financial education. Finally, financial socialisation (Shim et al., 2010) is identified as significant in predicting both financial literacy and positive financial behavior. Having discussed finances at home is positively associated with the advanced objective financial literacy scale, each of the subjective financial literacy items, and the likelihood of performing each of the positive financial types of behavior. Having previous studies in a related field is generally, but not always, associated with higher levels of objective and subjective financial literacy, and financial behavior. First, this underscores the need to include traits and prior socialisation opportunities when making evaluations. Second, this highlights an area worth future research focus. How can large financial education interventions such as those delivered at undergraduate level best cater for, and leverage off, the predispositions (i.e. traits) of students to improve intervention outcomes?

Author statement file

Undergraduate student financial education interventions: Medium term evidence of retention, decay, and confidence in financial literacy.

All work completed by Paul Gerrans.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pacfin.2021.101552.

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