

# Financial (il)literacy vs. individual's behavior: evidence on credit card repayment patterns

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## Abstract

We explore the role that financial (il)literacy and personal traits have on financial behavior. Using a sample of 156 college students from the United States, we provide unique empirical evidence by specifically differentiating between individuals with higher levels of financial literacy versus individuals declaring not knowing the answers to financial literacy questions and those answering incorrectly. Thus, we assess the implications of revealed lack of financial knowledge on financial behavior regarding credit card use in comparison with two other cohorts; cohort one answering correctly, and cohort two failing to answer correctly. A novelty of our study is that we contrast these results to the behavioral factors of over spending and surprised levels of spending—proxies for personality traits—when using credit card. Our exploratory empirical findings indicate that among personal-traits considered in this study overspending results in lack of payment in full in credit card debt, and more importantly these effects dominate any gains derived from financial literacy. To this extent financial literacy appears to only play a marginal role avoiding month-to-month credit card debt. Furthermore, financial knowledge derived from parents has a strong positive effect on individuals' financial behavior especially for students characterized by a relevant financial illiteracy. The implications of this research support the argumentation that early financial literacy may have the strongest effect in shaping individuals inherent behavior patterns; that is, early exposure to financial education is strictly preferred and should be promoted at early stages of the educational system. © 2021 Academy of Financial Services. All rights reserved.

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## 1. Introduction

Issues relating to financial knowledge and individual behavioral patterns are at the core of every individual's economic decision (Thaler & Shefrin, 1981). It is well documented that financially illiterate individuals incur in costly or even improper financial decisions with significant negative spillover effects on other aspects of their life (see Lusardi & Mitchell, 2007; and Van Rooij, Lusardi, & Alessie, 2011, 2012, among others). For instance, previous studies demonstrate (see Lusardi & Mitchell 2014, for an excellent review of the literature) that when young people possessing low levels of financial literacy and combined with a widespread use and easy access to credit cards (especially among college students), results in making the wrong financial decisions; most notably carrying over large balances in credit card debt. As a matter of fact, credit card debt coupled with financial illiteracy is associated with unhealthy behaviors (Adams & Moore 2007; Berg et al., 2010; Lyons & Rogers, 2004), lower academic performance (Pinto et al., 2001), and lower financial well-being (Grable & Joo 2006; Norvilitis et al., 2006; Nelson et al., 2008). The negative effects of poor financial decisions are well stated; however, what causes and fuels this behavior is a much lesser study field.

In this context, the role of personality traits, individual preferences with hyperbolic discounting, and attitudes in influencing financial decision-making have been less investigated to this date in the literature. This is more interesting as these issues are increasingly attracting the attention of psychologists and, and more recently yet to a lesser extent economists (see Brown & Taylor, 2014 and Barboza, 2018, for instance). Similarly, issues relating to one self's perception (i.e., confidence about one's knowledge or ability to conduct financial decision in particular) has been explored in the realm of behavioral economics and finance (Thaler, 1980; Thaler & Shefrin, 1981). However, despite these advances, it is only until recently that the combined elements have become a subject of analysis in conjunction. More specifically the actual financial knowledge showing that overconfident individuals, or those with high self-assessed knowledge but low actual knowledge, have a higher propensity to engage in risky (costly) financial behaviors (Tokar Asaad, 2015; Brown & Taylor, 2014; Chu et al., 2017; Kramer, 2016; Porto & Xiao, 2016; Xia et al., 2014).

On the basis of these considerations and given the importance that financial literacy plays in optimal decision-making processes, our paper aims at studying the relationship between individual behavior and financial (il)literacy. More specifically, we aim at providing robust empirical evidence useful to fill the gap where little attention has been given to study the impact of both financial literacy and of personality traits, preferences and attitudes on overall financial behavior measured as repayment patterns in credit card debt.

Specifically, we hypothesize that regardless to one's financial knowledge level, specific personality traits, such as present-bias preferences or impulse behavior, may negatively impact the financial decision-making processes and overpower the (potential) positive effects from higher level of financial literacy. Secondly, we hypothesize that self-awareness of not possessing a strong financial knowledge (admitted by choosing the Do Not Know option in a financial literacy questionnaire) may lead to more conservative financial

decisions. In turn these decisions could prevent individuals from assuming too much financial risk, resulting in a “correct” or less costly financial decision.

This paper studies credit cards use among college students as we investigate the financial behavior and decisions that college students make in terms of credit card repayment patterns. That is, whether students select to pay the credit card balance in full every billing cycle, or decide to carry a month-to-month balance, either by paying less than the full balance, by only the minimum payment (anchoring) or by falling behind on their payments. We use a sample of 156 college students from the United States and consequently estimate a series of ordered Probit models. Our results provide unique empirical evidence by creating a distinctive differentiation between individuals with higher levels of financial literacy versus individuals declaring not knowing the answers to financial literacy questions and those answering incorrectly. Due to the relevance that perception about oneself has on actual behavior, we bring forth the hypothesis that incorrectly answering financial questions versus answering “I do not know” may have potentially large implications relating to the way individuals react in the face of making—important—financial decisions. Besides, we account for a series of personality traits (namely overspending, anxiety, and mental accounting issues) to test for their effects on financial behavior (credit card repayment). An important finding of our study is that these personality traits may have stronger (negative) effects not easily overcome by higher levels of financial literacy.

As a spoiler alert, our exploratory results find robust evidence indicating that individuals’ personal traits are the main driver for individuals to accumulate and carry over a month-to-month balance in their credit card(s). Specifically, attitude towards overspending is the main factor negatively affecting the capability of individuals to repay in full credit card debt every billing cycle. This result is in line and provides statistical support to the importance of mental accounting issues faced by individuals with present bias preferences. We also find, contrary to previous literature (Norvilitis et al., 2006; Robb, 2011; Shim et al., 2009, 2010), that a higher level of financial literacy is not a fundamental and it only controls on the margin for personal traits and attitudes (overspending, lack of self-control, and issues related to poor mental accounting). Furthermore, financial knowledge derived from parents has a strong positive effect on individuals’ financial behavior especially for people characterized by high levels of financial illiteracy. Our findings reinforce the evidence of those studies that specifically investigated the relationship between the role of parents and the (mis)use of credit cards by college students (Hancock et al., 2013; Xiao et al., 2011). Our findings may serve policy makers when designing specific policies aimed at avoiding, or reducing, debt traps and socio-economic vulnerability of the borrower.

Our paper contributes to the extant literature in at least three strands. At this point we do not make any claim to make a theoretical contribution to the field. Our contributions are empirical and they are as follows. First, we provide a unique and innovative empirical break down between financial literacy and financial illiteracy. In particular we separate wrong answering to a standard financial literacy questionnaire (five questions in total; see Section 2 for more details on the questionnaire) between incorrect answering and *Do Not Know* responses. The former is classified as an attempt to respond and measures an overconfidence about one’s actual knowledge which at the end is revealed to be poor (Overconfidence). Whereas the latter represents a direct answer to not knowing and therefore to not possess overconfidence on his or her

knowledge level. It is relevant to point out that while at present previous research has studied the role of financial literacy (Correct/Incorrect) in decision making, little has been dedicated to study the relation to how much people actually *Do Not Know* or believe they do not know. Therefore, our central contributing focuses on accounting the magnitude and explicit separation between an inaccurate perception of knowledge level leading to incorrectly answering, versus individuals actually not knowing and clearly revealing this lack of knowledge.<sup>1</sup> To the best of our knowledge, we are the first to explore this issue.<sup>2</sup>

Secondly, we study the effect of consumption and spending patterns, as they relate to overspending (present bias) and surprised factors (inadequate mental accounting) as they lead to credit card debt accumulation. The issues at stake here are similar to those first introduced by Thaler (1980) and Thaler and Shefrin (1981) on the different effects that individual mental accounting patterns may have between a planner (sophisticated self) and doer (naïve self). More specifically, the decisions individuals have to make include but are not limited to borrowing money, using credit cards, and adjusting consumption to income flows and avoiding falling prey of present-bias behavior and consequently accumulate a month-to-month balance on their credit card. In this context we then hypothesize that those with higher levels of self-awareness have the knowledge to answer correctly (basic financial literacy questions) or recognize their limitations and face the reality of not knowing the answer, and openly recognizing that by answer *Do Not Know*. Consequently, here our interest is to uncover the differences between those that are aware of their limitations versus those that are or possess excessive self-confidence, while being wrong. It is in this difference that we expect to reach relevant findings as to why individuals with certain personality traits are more likely to make incorrect and costly financial decisions. We believe this is the first paper that directly addresses this very important and timely issue.

Finally, our third contribution is to study the role of financial literacy in ameliorating negative effects of costly personality traits on credit card repayment patterns. The extant literature assumes that higher levels of financial literacy are a predominantly determinant of superior financial performance. However, while significant contributions have been made in advancing the role of financial literacy, previous works in this field have paid little attention to the role that personality traits (aptitude and attitude) play in financial decision and secondly what the role of financial (il)literacy is in shaping these inherent behavioral patterns.<sup>3</sup>

We organize the rest of the paper as follows. The next section reviews the most relevant literature on financial literacy and personal traits and sets forth our testing hypotheses. The third section describes the research design and the estimation model. The fourth section analyzes estimation results, which are then discussed in the fifth section, while the last section presents some general conclusions and policy recommendations.

## 2. Literature review

Recently the topic of financial literacy has received increased and extensive attention in the literature. The literature argues in favor of the relevance of adequate and timely financial literacy as paramount on individual decision-making process and their outcomes. In fact, the evidence points out in support of the argument that low levels of financial literacy are not only linked with high levels of personal and household debt (Lusardi & Tufano, 2009;

Moore, 2003; Stango & Zinman, 2009), inadequate retirement planning (Hilgert, Hogarth, & Beverly 2003; Lusardi & Mitchell, 2007), or inadequate stock market participation (van Rooij, Lusardi, & Alessie 2011), but also to poor health (Joo & Garman, 1998) or adverse health choices (Peters et al., 2007) and in general poorer overall life outcomes. In this respect, widespread financial illiteracy among young people is of particular concern for two main reasons. First, as they enter adulthood, a number of important financial decisions are to be undertaken (such as financing college studies; moving away from home; purchasing their first car; using credit cards; saving for retirement; etc.), for which they might not be adequately prepared. Misguided financial decisions in the early stage of their lives could have potentially disastrous consequences (huge debt, a poor credit rating, and inadequate retirement plans) for the remaining of their whole life (Schagen & Lines, 1996; Lusardi, Mitchell, & Curto 2010). Second, a lack of financial literacy seems to impact students' university performance as noted by Kezar and Yang (2010) whom suggest that a student's academic achievement is negatively affected by financial distress, which, in turn, is a more likely outcome in presence of low levels of financial literacy. In particular the literature documents that inadequate financial skills (especially in the area of cash management) result in higher level of stress and even anxiety with significant (negative) impact on academic performance (Kapoor et al., 2006; Razafimahasolo et al., 2016; Xiao et al., 2011). Low financial capabilities generate financial stress and anxiety, which in turn create negative spillover effects into other life dimensions.

In more recent research, particularly in the last decade, the majority of theoretical and empirical literature on financial literacy has addressed and investigated many different topics. These topics cover from the influencing factors that drive financial literacy to the methodological approaches to best treat survey questions that try to effectively measure a latent variable such as financial literacy.

A general agreement has been reached such as on the necessary prerequisites to gauge financial literacy (including the types of knowledge that best motivate and facilitate financial action). It has now become common knowledge that financial literacy among both adults and the young is low; and influenced by socio-demographic factors, such as gender, education, income, employment status, and age. It is also recognized that informal sources of education such as family background and interaction with peers are of particular importance in this regard (see Lusardi & Mitchell, 2014, for a review of theory and empirical evidence). More specifically, individuals' financial literacy seems to be significantly and positively associated with parental educational attainment and with the presence of forms of financial socialization within the family and the group of peers (for instance children observing their parents' saving behavior or receiving a more formal financial education from them). In general, the literature also agrees that young adults receive financial literacy through two main sources, parents and the educational system (Lusardi et al., 2009). In particular, Lusardi et al (2009) note that young adults with college-educated parents tend to have a better understanding of financial concepts. Mandell (1997) provides evidence on the role that proper types of financial education play as a significant factor in achieving financial literacy, while others indicate that much of the financial education is being conducted through business and community organizations, and not through educational institutions (Fox et al., 2005).

However, despite that the role of diversity (e.g., gender, ethnicity, age, and education) has been well documented, including considering different settings and time spans, our understanding of the mechanisms and channels of how these forms of diversity continue to result in significant gaps in financial literacy and consequently results in pervasive effects, remains a conundrum. The quest to find solutions to these differences is far from complete. This challenge is more complicated given the plethora of methodologies used to assess financial literacy. To date, the issue of assessing financial literacy has concentrated on the conceptual definition of this latent variable. Houston (2010) and Remund (2010) provide a thorough literature review that helps frame the issue of the conceptual definition of what financial literacy is or should be. Indeed, financial literacy has been variably defined as specifically referring to a form of knowledge (e.g., Hilgert, Hogarth, & Beverly, 2003), the ability to apply that knowledge (e.g., Mandell, 2008), or good financial behavior (e.g., Moore, 2003). The constructs used to measure financial literacy vary quite substantially according to the different conceptual definitions adopted. In fact, the construct either covers a wide variety of financial topics, including debt, insurance, spending, investments and retirement savings, budgeting, and inflation, or focuses on a few financial issues. Accordingly, the number of questions used to assess financial knowledge levels varies widely, ranging from three to 45 total items.

Across studies, both multiple-choice questionnaires and self-report questions have been employed to measure financial literacy; where the former are knowledge based and the latter assess perceived knowledge. More recently, surveys have been designed to gauge both objective knowledge and perceived knowledge. In general, considerable progress has been achieved in the design of surveys aimed at identifying individual levels of financial literacy through the effort made by the OECD and its International Network on Financial Education (INFE). Jointly they develop and promote a common questionnaire based on the experience of a large number of previous rigorous national and international surveys. The OECD/INFE (2012) report describes the questionnaire's underlying methodology and Kempson (2009) provides further details on this subject.<sup>4</sup> Due to its importance, research on financial literacy has in fact inspired numerous public initiatives at both the national and international level. Several countries now have financial literacy initiatives and strategies in place to increase the levels of financial understanding and knowledge among all citizens.

In contrast, it is not until very recently, that the process of data analysis (i.e., of analyzing the information obtained through questionnaires) has taken a central role in exploring the difference between financial literacy and illiteracy. That is to say, the emphasis has been on what is known but not in what it is not known. In other words, the research focus has been placed on people thinking that they know enough to be correct, but not realizing that they do not know enough to be correct. Due to the large arrays of data sources, it has become necessary to use both bivariate (ordered data from less to more) and multivariate techniques to quantify financial (il)literacy. In general, responses to the stated questions are simply summed to generate an index (score) of financial literacy, which typically ranges between zero and the maximum number of correct answers.<sup>5</sup>

A common practice to most studies is to cluster the “Do Not Know” responding with “incorrect” answers, in opposition to “correct” answers, notwithstanding the fact that it is

also widely recognized that these two types of responses (DNK and Incorrect) might refer to two distinct kind of respondents, with diverse (financial) educational needs. Manton et al. (2006) were the first to signal that college women tend to select “don’t know” response more frequently than men, especially on more numerically oriented subjects. In the same vein, Lusardi and Mitchell (2014) pointed out that “one twist on the differences by sex, (. . .) is that while women are less likely to answer financial literacy questions correctly than men, they are also far more likely to say they ‘do not know’ an answer to a question, a result that is strikingly consistent across countries.” However, so far, the common choice throughout the empirical literature is to include them in the same cluster of wrong answers for methodological issues. Exceptions to this practice are two recent papers by Chen and Garand (2018) and Kim and Mountain (2019). Kim and Mountain specifically address the econometric issue of misleading results obtained from ignoring DNK responses and suggest the use of binomial-latent regression models to prevents distortions from DK/RF responses. Chen and Garand (2018) deepen the well-known issue of gender gap in financial literacy, by giving specific attention to DNK answers. In particular, after having ascertained that women may exhibit lower levels of financial knowledge because they lose the opportunity to hazard a guess and arrive at a correct answer based either on partial knowledge or on random chance, they consider the possibility that there are psychological processes at work involving risk acceptance and confidence in financial knowledge that prompt women to give DK responses at a rate higher than men. As a result, they suggest that future research should consider the relative roles of DK and incorrect responses in measuring financial knowledge.

In this study, we follow such a suggestion and aim to contribute to the extant literature by treating respondents, who admit not knowing, differently from those respondents who implicitly consider themselves as knowledgeable but in fact possess a “wrong” knowledge. As a matter of fact, when self-assessed questionnaires are included in multiple choice questionnaire (testing objective knowledge), the evidence indicates that most people are unaware of their own shortcomings, as there is often a substantial mismatch between people’s self-assessed knowledge versus their actual knowledge (Lusardi & Mitchell, 2014). This incorrect assessment is also directly related to the research on behavior as presented by Thaler and Shefrin (1981). In particular, we take particular interest in separately scoring “Correct,” “Incorrect,” and “Do Not Know” answers and conjecture that admitting of not possessing a proper financial knowledge may lead to more conservative financial decisions, that could prevent taking too much financial risk. In addition, we approximate the measures for present bias and mental accounting biases as noted next.

We also take a cue from a growing body of literature acknowledging that the drivers of financial choices are not constraint just by knowledge and the acquisition of basic information. In this new stream of research cognitive biases, individual psychological traits and aptitudes, motivations, and timing of the choice to be undertaken are all examples of the behavioral and psychological constraints that interact with economic decisions in general and financial choices in particular. One specific cognitive bias that has attracted much attention in empirical studies connecting financial decisions, behavioral biases, and financial knowledge is overconfidence on one’s actual ability, performance, level of control, or chance of success (Moore & Healy, 2008). Financial confidence, in particular, reflects a self-assessed level of financial knowledge, which may or may not coincide with measured financial

knowledge. Financial literacy overconfidence has been linked to various risky behaviors such as higher stock market participation (Xia et al., 2014), less use of financial advice (Kramer, 2016; Porto & Xiao, 2016) and a preference for direct stock investment rather than in less risky/more diversified mutual funds (Chu et al., 2017) or greater likelihood of engaging in risky (costly) financial behaviors, such as taking out a title-loan, or a short-term payday loan (Tokar Asaad, 2015).

From this perspective, we take particular interest in the literature on behavioral economics which assumes, and dictates consequently, that individuals may acquire debt, adjust repayment capabilities, and adhere to differentiated patterns of repayment away from the neo-classical rational expectations teaching. The general consensus is that rationally behaving individuals have perfect foresight, are rational and apply consistent discounting rules on consumption. On the other hand, the literature on behavioral biases proposes the existence of several factors governing individuals' behavior. Particularly, issues relating to hyperbolic discount functions in consumption – present bias –, naïve behavior, lack of self-control and impatience (Akerlof, 1991; Kuchler 2013; Laibson, 1997; O'Donoghue & Rabin, 1999; Thaler & Shefrin 1981; Thaler 2018, among others) may lead to patterns of consumption, which fueled by easy access to credit cards may result into too much debt accumulation and patterns of procrastination on repayment (Barboza, 2018). Although aware that the psychological literature on personality traits is not confined to and is richer than that just mentioned on behavioral biases, in this study we are interested in highlighting and measuring those individual features that characterize one's pattern of consumption and savings and manifest: (1) in a tendency to overvalue immediate rewards (I buy what I like now, disregarding the issue of affordability of the purchase), while putting less worth in long-term consequences (I will think tomorrow how to find the money to afford the purchase); (2) in a process, known as mental accounting, whereby individual expenses will not be considered in conjunction with the present value of one's total wealth.<sup>6</sup> Instead it is considered in the context of the current budgetary period and the category of expenses, leading to constraints/relaxations of purchases irrespective to the whole—same—fungible resource that is income plus (eventually) personal net worth (Cheema & Soman, 2006; Zhang & Sussman, 2018) and a greater willingness to pay for goods when using credit cards than cash (Prelec & Simester, 2001).

At the same time the procrastination of debt payment can cause pain and anxiety concerns which feedback into the repayment behavior individuals display next period. We follow a recent strand of literature (Andrews & Wilding, 2004; Fiksenbaum et al, 2017; Marjanovic et al., 2013) who define an emotional state, such as financial threat, referring to self-reported fearful-anxious uncertainty regarding one's current and future financial situation. In this study we take particular interest in the effect that higher financial anxiety may have on credit card repayment behavior.

Thus, we propose to study the combined and interaction effects of financial (il)literacy and personality traits, as they relate to credit card repayment patterns. With these considerations in mind, then the backbone of our analysis is driven by the following set of hypotheses.

*Hypothesis 1:* Higher levels of financial literacy—measured as higher number of correct answers—lead to better repayment rates in credit card debt.



*Hypothesis 2:* The higher the transgenerational transmission of financial education from parents to children results in improved repayment in credit cards.

*Hypothesis 3:* Individuals with self-assessed lower level of financial literacy (DK answers) display diverse behaviors (credit card repayment patterns) as opposed to individuals who do not possess basic financial literacy (wrong answers).

*Hypothesis 4:* Individuals displaying present bias, improper mental accounting and or impulse behavior and financially derived anxiety are less likely to display proper financial behavior (i.e., pay credit cards in full) and consequently carry month-to-month balance.

*Hypothesis 5:* Positive effects from higher levels of financial literacy could be overpowered by personal traits. This is to say, that financial literacy may or may not be enough to counter inherent negative traits that individuals already possess.

### 3. Method

#### 3.1. Data and variables

Data for this research comes from a survey administered to three samples of business college students in the United States, attending a Midwest Higher Education University and a Mid-Atlantic University. The survey was paper based and administered in person to a total of 1,149 students. Data were collected in 2015 and the total complete sample size useful for our analysis is of 156 respondents.

The sample is composed as follow: 45.50% are female students and 54.50% are male students; minority represents 21.2% whereas White race students are 78.8% of the sample. In terms of academic status, freshman students are 32.05% of the sample, Sophomore students 8.97%, Junior students are 20.51%, Senior students are 36.54%, and Graduate students only 1.93%.

The main interest of this study is to explore the effects that financial (il)literacy and individual personal traits related to purchasing behavior have on their financial behavior as manifested in credit card repayment patterns. Thus, we measure financial behavior as an individual's credit card repayment pattern and ask questions regarding credit card repayment behavior, such as: Pay if full every month; Pay some in full and then only the minimum required; Pay more than minimum required but not in full; Pay Minimum required; or Pay less than Minimum required. We create the categorical variable used to estimate the ordered Probit model and corresponding probabilities of occurrence.

The survey also includes a combination of questions related to personal traits and financial (il)literacy elements. Regarding financial literacy we post five financial literacy questions to students (see Fig. 1 for details) that tests the basic financial concepts traditionally tested in the financial literacy literature since Lusardi and Mitchell (2007) proposed them: inflation, time value of money, diversification, and interest rate compounding.

The survey also includes a set of questions designed to capture specific personality traits. These variables serve as proxies to assess individuals' time preferences (present bias issues),

**Question 1:** Suppose you had US \$ 100 in a savings account and the interest rate was 2% per year. After two years, how much do you think you would have in the account if you left the money to grow?

1. More than \$102
2. Exactly \$102
3. Less than \$102
4. Don't know

**Question 2:** Imagine that the interest rate on your savings account is 2% per year and inflation is 3% per year. After one year, how much would you be able to buy with the money in this account?

1. More than today
2. Exactly the same
3. Less than today
4. Don't know

**Question 3:** Assume a friend inherits US \$ 10,000 today and his sibling inherits US \$ 10,000 three years from now. Who is richer because of the inheritance?

1. My friend
2. His sibling
3. They are equally rich
4. It depends
5. Don't know

**Question 4:** Suppose that in 2012, your income has doubled and the prices of all of the goods and services that you consume have also doubled. In 2012, how much were you able to buy with your income (assuming that you did not change your spending habit)?

1. More than you did in 2011
2. Exactly the same
3. Less than you did in 2011
4. Don't know

**Question 5:** What do you think of the following statement "Buying a single company stock usually provides a safer return than a stock mutual fund"?

True      False      Don't know

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**Note:** Correct answers are Q1=1; Q2=3; Q3=1; Q4=2; Q5=False

Fig. 1. Financial literacy questions.

issues relating to mental accounting, and potential issues relating to procrastination and lack of commitment. Based on the review of the literature we argue that these topics may manifest in turn in behavioral delays on credit card repayment, as purchase may be in excess to monthly repayment capabilities. Therefore, to further understand individuals' decision-making process, subjects were asked if they were surprised at the end of the billing cycle with the balance the credit cards has reached, and secondly if they have engaged in purchases knowing that they did not have money to pay it in full when the balance was due. We define these two variables as *Surprised* and *Overspending*, respectively. In both cases, our tentative hypothesis is to expect that the higher the level of *Surprised* and the higher the amount of *Overspending* lead to a worsen in credit card repayment patterns in the next billing cycle.

To identify one's personal attitude toward debt repayment we include the variable *Anxiety* where the variable takes the values according to the following scale: 1= *not anxious at all* and 5 = *extremely anxious*. In our survey, students self-report the level of their financial anxiety answering to a specific question of the survey. Anxiety is in relation to how the person feels when he or she has to pay the credit card bill at the end of the billing cycle.

Finally, in addition to financial literacy questions our survey also considers a financial education question. In particular we analyze the role that parents may play in the buildup of the financial literacy levels of their children. The survey asks whether their parents were the primary source of financial education and we define a dummy variable *FePar* when parents are reported as the main source of financial education. In line with the transgenerational effect found elsewhere (Barboza, Smith, & Pesek 2016), we argue that if parents are the main source of financial education, parents' financial experiences serve as a mechanism to develop knowledge spillover effects and possibly avoiding painful self-experiences that could result in lower levels of financial-based anxiety and translate onto better credit card repayment patterns.

Based on the number of correct answers to the financial literacy questions, we first proceed to construct the cumulative number of Total Correct Answers. The number of correct answers is thus the actual level of financial literacy (that we called Financial literacy rate), as it is presented in most of the extant literature. We take particular interest in the objective separation between Correct, Incorrect, and Do Not Know answers. Therefore, we construct the variable total number of incorrect answers given by each individual, and call it Financial Illiteracy Level A. Finally, we construct the total number of answers under the Do Not Know category. As noted earlier, we want to emphasize that answering incorrectly is different than answering Do Not Know. Correspondingly, answering DNK is labeled as Financial Illiteracy Level B. We argue that those answering incorrectly (Incorrect) have attempted to answer assuming that they have an adequate level of knowledge; however, clearly failing to achieve a correct answer. On the other hand, those answering I Do Not Know (DNK) openly acknowledge that they are not prepared to even attempt answering recognizing a higher level of financial illiteracy with no fear to state it as such. The fundamental difference is that the DNK group may be less ready to engage in financial decision-making processes, as their self-awareness indicates a clear lack of preparation. Conversely, those responding incorrectly (Level A) implicitly assume knowing the answer but failing. The potential implications of the separation of answering not correctly into these two distinctive groups could be relevant in understanding the implications of different levels of financial illiteracy. We also

Table 1 Financial (il)literation indicators per question

	Correct	Do Not Know	Incorrect
Compound interest	70.3%	6.0%	23.7%
Inflation	66.8%	16.1%	17.1%
Inheritance	33.5%	3.1%	63.3%
Purchasing power	77.2%	8.2%	14.6%
Risk	51.0%	40.1%	8.9%

provide a decomposition of answers (under the three categories) by question as these relate to different financial concepts.

### 3.2. Descriptive statistics

Table 1 presents a summary of results from the questionnaire. These results indicate that a large majority of individuals answer correctly questions on Compound interest, Inflation and Purchasing Power. A large number of students were not capable of answering correctly the question regarding Inheritance. In terms of the inflation question, a relative similar proportion of individuals answer DNK or incorrectly. For the risk question a significant number of students responded DNK. In general, the data appears to indicate that DNK answering is a prevalent issue. In addition, a large number of student answer incorrectly. The combination of both levels of financial illiteracy confirms the prevalence of wide spread lack of financial knowledge.

When we look at the cumulative answering (see Table 2, below), we observe that 5% of the population are not capable of answering any question correctly. By the same token, only 12% of the individuals are capable of answering all questions correctly. In addition, a large proportion of individuals answer DNK to one and two questions. When combined with those also answering incorrectly one to two questions, we are able to observe a large proportion of the population struggling with about 50% of the questions asked. In general, this evidence indicates that financial illiteracy is highly present among the population under study. This statistic is in line with previous literature and with most recent valuations made across the U.S. population (see Lusardi & Mitchell 2014). Table 3 disassembles financial literacy rate by demographics. The interpretation of the results thus indicates that females are more likely to answer correctly since people able to provide five correct answers are mainly females (62.5%); this is a result that contradicts the empirical evidence found in the literature for the United States (Borden et al. 2008; Chen & Volpe, 2002; Danes & Tahira, 1987; Lusardi,

Table 2 Financial (il)literation indicators (total answers)

No. of answers	Correct	Do Not Know	Incorrect
0	4.9%	52.9%	22.1%
1	10.0%	31.4%	41.9%
2	18.0%	9.2%	25.9%
3	27.4%	3.1%	7.6%
4	27.7%	2.2%	1.5%
5	11.9%	1.0%	1.0%

Table 3 Financial literacy rate by demographics

Financial literacy rate	Gender mean	AS mean	Age	Race
0	0.333	1.939	20.152	0.697
0.2	0.313	2.119	20.373	0.731
0.4	0.430	2.421	20.554	0.777
0.6	0.492	2.415	21.196	0.837
0.8	0.478	2.595	21.978	0.892
1	0.625	2.838	23.213	0.938

*Source:* Demographic variables are defined as follows. Gender *G* is a dummy variable taking value of 1 if female and 0 otherwise. Academic Status-*AS* is the 1 = Freshman, 2 = Sophomore, 3 = Junior, 4 = Senior, and 5 = Grad Student. *Race* is 1 if White and 0 if minority. *Age* is expressed in years at the time of the survey. *FLITRATE* is the percentage of correct answers provided, based on a five question questionnaire as presented in Figure 1.

Mitchell, & Curto, 2010; Markovich & DeVaney, 1997) where it is argued that females possess lower levels of financial literacy. However, outside the United States, this is not a standard evidence (Bongini et al, 2016; Koshal et al., 2008; Wagland & Taylor, 2009) when specifically studying Business Students.

In addition, older students are more likely to answer correctly, as well as upper classmen or classwomen. Among different academic status graduate students provide at least three correct answers and the 33% of students answers correctly to all the financial literacy questions. This interpretation of the results speaks in favor of the educational process. As expected, one can argue that attending college should increase knowledge in field specific subjects, financial literacy being one of them. Finally, the evidence does indicate that minorities are at a disadvantage and more likely to answer incorrectly or do not know. This last piece is in agreement with the extant literature.

Table 4 below presents some basic descriptive statistics on the variables used in the empirical estimation section. A full description of each variable and its corresponding coding could also be found there. With these considerations in mind, we then proceed to outline the model specification and the corresponding model estimations expectations and restrictions.

### 3.3. The model

As we research the effects of personal traits and financial literacy on financial behavior, the basic model description has the following general specification:

$$y_i^* = x_i' \beta + \varepsilon_i \quad (1)$$

where  $\varepsilon_i$  are assumed independent and identically distributed random variables as usual,  $x_i'$  is the matrix of explanatory variables (financial (il)literacy and personality traits),  $\beta$  is the vector of coefficients to be estimated, and  $y_i^*$  is unobserved yet described by the answers to our survey questions relating to credit card repayment habits.

In fact, we code students' responses on credit card repayment capability using a discrete categorical scale as follows: 1 = *pay if full every month*, 2 = *pay some in full and other only*

Table 4 Descriptive statistics of variables by category, description, and coding

Category	Description	Code	Median	Mean	SD	Max	Min	Obs
Demographics	Academic status (F = 1, S = 2, J = 3, Sr = 4, Grad = 5)	AS	3	2.673	1.311	5	1	156
	Gender (female = 1)	G	0	0.455	0.512	2	0	156
	Age	AGE	20	20.603	2.853	42	18	156
Financial education and literacy	Race (minority = 0)	RACE	1	0.788	0.410	1	0	156
	Parents are main source of financial education	FEPAR	1	0.628	0.485	1	0	156
	Numbers of correct answers	TotCor	3.00	2.878	1.262	5	0	156
	Numbers of incorrect answers	Tot_Inc	1.00	1.391	1.032	5	0	156
	Number of “Do Not Know” answers	TotDK	1.00	0.731	0.868	4	0	156
Behavioral	Level of anxiety on repayment capacity	Anx	2	2.019	1.116	5	1	156
	Frequency of payment on credit card	Rfreq	1	1.622	1.012	4	1	156
	Surprised on CC balance level	Surp	1	0.878	0.918	3	0	156
	Frequency of overspending	Overspd	0	0.462	0.822	3	0	156
	Number of credit card	NCC	1	1.564	1.061	6	1	156

Source: Demographic variables are defined as follows. Gender **G** is a dummy variable taking value of 1 if female and 0 otherwise. Academic Status-**AS** is the 1 = Freshman, 2 = Sophomore, 3 = Junior, 4 = Senior, and 5 = Grad Student. **Race** is 1 if White and 0 if minority. **Age** is expressed in years at the time of the survey. Financial Literacy, Education, and related variables include the following. **TotCOR** is the number of financial literacy question answers correctly; **TotDK** is the number of answers with a “Do Not Know” answer; and **Tot\_INC** is the number of incorrect answers. For each individual the sum of **TOTCOR** + **TOTDK** + **TOT\_INC** = 5. The Financial Literacy Rate-**FLiRate** measures the percentage of correct answers out of the five literacy knowledge questions. Anxiety-**Anx** is the level of anxiety reported on a scale from 1 = no anxiety to 5 = extremely anxious in relation to his or her capacity to repay your credit card monthly bill. **FEPAR** takes a value of 1 if parents are the main source of financial education, 0 otherwise. **RFreq** defines the repayment behavior on credit cards. The variable takes the values of 1 = Pay in Full; 2 = Pay more than minimum, but carry month-to-month balance; 3 = Pay off some credit cards, but pays minimum on the rest; 4 = Pay minimum in all; 5 = Pay less than minimum in all. 6 = 1 = Parents pay in full will be the assumption. **Surprised** defines the level of surprise the individual reports on how high of a balance is on the monthly statement. The variable takes the values of 0 = never, 1 = Rarely, 2 = Sometimes, 3 = Frequently. **Overspd** defines the behavior of the individual regarding the individual knowing that she or he use the credit card knowing that she or he did not have money to pay when the bill came due. The variable takes the values of 0 = never, 1 = rarely, 2 = sometimes, 3 = frequently. Finally, **NCC** is a count variable measuring the number of credit cards an individual possesses.

*minimum required*, 3 = *pay more than minimum required but not in full*, 4 = *pay Minimum required*, 5 = *pay less than Minimum required*. Therefore, our dependent variable (*Rfreq*) takes discrete values along the scale 1 to 5. Notice that *Rfreq* of values ranging from 2 to 5 results in accumulation of month-to-month balance, with the risk of incurring high financial costs related to interest rates and possibly other assessed fees.

In consideration of the ordinal nature of the dependent variable, the most appropriate model to use is an ordered Probit model. The main difference among the models regards the financial literacy variable. Due to our interest to test for both knowledge and lack of knowledge, we decompose the responses given by individuals between correct, incorrect and do not know classifications, per our discussion in the previous section. In the first model we consider as Financial literacy variable the number of correct answers. In the second model we consider the number of questions where the students said that he does not know the answers, and in the last model we consider the number of incorrect answers. Furthermore, because each of the financial literacy questions measures knowledge of different financial issues (more or less directly related to our dependent variable, i.e., credit card repayment), we also proceed to conduct estimations by question.<sup>7</sup> Thus, we propose to estimate the impact of each financial issue on the financial behavior under investigation: our intuition is that some questions may be more relevant (have a larger impact) and the separation of effects may yield relevant results, when understanding credit card repayment patterns.

In all the specifications, we consider all the personality trait variables and the presence of financial education from parents; plus, as control variable we include the total number of credit cards possessed by our sample students (NCC). This latter variable proves to be very much correlated to the usual demographics variables (age, gender, race, and academic status) used as controls; we choose to use NCC as our single control variable because the number of observations suggested to contain the number of covariates.<sup>8</sup>

We then proceed to incorporate interaction effects between the overall scores of financial literacy, financial illiteracy Level A (Incorrect) and Level B (DNK), in relation to the financial education from parents and personality trait variables. In addition, and due to the possibility of endogeneity in the data, we conduct Hausman testing as a robustness indicator. The argument regarding endogeneity is justified as the possibility of a self-selection problem in terms of the characteristics of those selecting to apply and obtain a credit card. However, the counter argument indicates that in the U.S. market, young adults need to apply for credit cards as a requirement to begin building their credit history and create a credit score. Due to this apparent controversy, we apply the endogeneity testing.

#### 4. Results and discussion

Estimations are presented in Table 5 where each of the three models is further decomposed to study the impact of each financial issue included in the financial literacy index on credit card repayment behavior of individuals.

When looking at the coefficients (sign and magnitude) of the total number of questions answered (Correctly, Incorrectly, and DNK, respectively) we observe that correct/DKN hold

Table 5 Consumer behavior and financial decision making process with credit card repayment as dependent variable

	Model 1 Correct answers		Model 2 Incorrect answers		Model 3 Do Not Know answers	
	1.1	1.2	2.1	2.2	3.1	3.2
Financial educ parents	−0.939 (0.001)***	−0.973 (0.001)***	−0.930 (0.001)***	−0.969 (0.001)***	−0.912 (0.001)***	−0.888 (0.001)***
Anxiety	0.143 (0.18)	0.124 (0.25)	0.158 (0.13)	0.141 (0.18)	0.163 (0.12)	0.159 (0.11)
Surprised	0.143 (0.28)	0.130 (0.33)	0.141 (0.25)	0.133 (0.27)	0.182 (0.16)	0.175 (0.17)
OverSpending	0.533 (0.001)***	0.533 (0.001)***	0.506 (0.001)***	0.497 (0.001)***	0.509 (0.001)***	0.511 (0.001)***
NCC	0.161 (0.08)*	0.156 (0.10)*	0.164 (0.04)**	0.169 (0.04)**	0.135 (0.13)	0.144 (0.08)*
Financial literacy questions						
Total answers	−0.150 (0.10)*		0.222 (0.03)**		−0.022 (0.88)	
Compound interest		−0.017 (0.95)		0.020 (0.94)		−0.051 (0.91)
Inflation		−0.385 (0.12)		0.501 (0.05)**		−0.014 (0.97)
Inheritance		−0.107 (0.68)		0.163 (0.47)		−0.184 (0.41)
Purchasing power		−0.046 (0.87)		0.118 (0.72)		−0.125 (0.82)
Risk		−0.139 (0.55)		0.297 (0.35)		0.022 (0.92)
Pseudo $R^2$	0.209	0.212	0.212	0.217	0.197	0.199
Obs	158	157	156	156	156	156
LR statistic	65.06	65.71	65.59	67.29	61.10	61.66
Probability (LR stat)	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
Akaike info criterion	1.674	1.726	1.681	1.722	1.710	1.758
Schwarz criterion	1.848	1.979	1.857	1.976	1.886	2.012
Hannan-Quinn criterion	1.744	1.829	1.753	1.825	1.782	1.861

Note: \*\*\*, \*\*, \* statistically significant at the 1%, 5%, and 10% level, respectively.

both a negative sign, while only Correct being statistically significant at the 10% level of confidence. The negative sign indicates that higher levels of literacy and/or declaring DKN result in better repayment patterns. Higher financial literacy having a positive impact on repayment is an expected outcome (confirming Hypothesis 1); however, the second component (DNK) is clearly a puzzling result. Notice that higher levels of financial literacy are only marginally statistically significant at the 10%. Regarding incorrect answering (financial illiteracy) the result is statistically significant and with the expected positive sign. This result supports the hypothesis that lack of financial literacy creates a negative effect on individuals' financial performance, resulting in an accumulating month-to-month balance in their credit card debt (Hancock et al., 2013; Robb, 2011; Xiao et al., 2011). Furthermore, results in



Models 2.1 and 3.1 clearly indicate that individuals responding incorrectly are significantly more likely to incur in poor credit card repayment behavior. The estimated coefficient is larger than the Correct counterpart and holds a positive sign and has a higher level of statistical significance. Perhaps the most revealing result of the estimations in Table 5 is the support to our third hypothesis that Incorrect answering and DNK answering have different implications on Credit Card repayment patterns. That is, the common practice in previous research to cluster any answering that is not correct as incorrect, seems to be not an appropriate way to understand the effects of different levels (A and B) of financial illiteracy. In summary, our findings confirm Hypothesis 1: higher levels of financial literacy (measured as higher number of correct answers) lead to better repayment rates in credit card debt but also Hypothesis 3 individuals with self-assessed lower level of financial literacy (DKN answers) display diverse behaviors (credit card repayment patterns) as opposed to individuals who do not possess basic financial literacy (wrong answers).

Our findings also confirm Hypothesis 2 and to a lesser extent Hypothesis 4. First, we observe that the variable **FePar**, being the main source of financial education, is highly significant in all models and negatively associated with repayment habits. This result indicates that individuals that receive their education from parents are more likely to have better repayment behavior on her or his credit card.<sup>9</sup> This result also confirms the importance of parental involvement in kids overall financial education aspects. Our findings confirm Hypothesis 2: the higher the transgenerational transmission of financial education from parents to children results in improved repayment in credit cards.

With respect to personality traits also control for the presence of personality trait (Surprised, Anxiety, and Overspending) our estimates highlight that individuals' capability to repay their credit cards is driven by the use factor and only marginally by the knowledge component. In all the models, the role of Overspending impacts negatively the capability to repay credit card debt. The other variables, Anxiety and Surprised, are not statistically significant. As a consequence, our Hypothesis 4 is partially confirmed, at least with respect to present-bias preferences. Recall that overspending is the response to individuals actually buying when they knew a priori that he or she would not have enough money to repay the credit card at the end of the billing cycle. We argue, thus, that the overspending coefficient serves as a measure of present bias behavior as well as an indicator of lack of self-control. This lack of self-control becomes a materialized purchase due to the availability of credit cards. If the individual were not to have a credit card, he or she could not complete the purchase. While this may seem obvious, it is relevant to point out that this behavior clearly results in increased financial costs of the purchases, as individuals know ahead of time that they will incur in a rolling debt. Notice also that the estimated coefficient value for Overspending is consistent across all alternative models, even when controlling for financial (il)literacy.

Finally, the NCC yields the expected positive sign indicating that individuals having more credit cards are more likely to hold a month-to-month balance: in our estimations an increase in the number of credit cards made the capacity of repayment worse. As hypothesized earlier, a higher number of credit cards may be the result of maxing out of credit on one card and consequently apply for more; or using new credit cards to transfer balances (at promotional interest rates).

Due to the possible gains in understanding individuals' behavior on credit card repayment patterns we proceed with a further decomposition of the financial (il)literacy by question. First, notice that under the Correct model (1.2), all five questions have the expected negative sign (answering correctly results in better credit card repayment patterns) even though none individually is statistically significant. In contrast, model (2.2), yields opposite signs in all five questions in relation to the Correct model version. These differences in results are consistent with expectations, and apparently strong enough to explain the overall positive sign of the total number of incorrect answers. Lastly, the DNK model (3.2) provides results that are more congruent with the correct estimations than the incorrect estimations; thus providing further evidence in favor of the hypothesis that clustering incorrect with do not know is not an appropriate way to understand different levels of financial illiteracy.

However, given the results from the alternative estimations in Table 5, we confirm that the role of financial literacy, or lack of, appears not to dominate behavioral/personal traits (Hypothesis 5). This is to say, that financial decisions seem to be made primarily along pattern of behavioral traits and financial education from parents; and in this context only marginally ameliorated by financial education. Assuming that these results are consistent and robust (after accounting for possible sample issues) then, they indicate that while financial literacy is an important or fundamental element for all individuals to learn, behavioral variables drive the accumulation of credit card debt and result in less than optimal repayment. In this respect, we confirm the findings of Xiao et al. (2011) who, applying the Theory of Planned behavior to investigate risky credit behavior among college students, found that behavioral intentions were the single most important factor in whether students make responsible credit decisions (risky borrowing behavior, risky paying behavior, and holding credit card debt). Under these conditions, it then becomes relevant to explore the drivers of overspending.

Given the robustness of the personal trait variables, in conjunction with the lack of strong statistical significance of the financial literacy estimates, several possible scenarios come to mind. For instance, we can argue as mentioned above that behavioral traits are just too strong and clearly individuals have a hard time controlling them. Particularly, issues relating to present-bias, preferences and gaps in mental accounting are strong and present. In addition, one can argue that this behavior may be prevented or ameliorated with early intervention in the form of exposure to financial literacy. That is, there is the possibility that students in our sample may be receiving financial education too late in life, and thus personality traits are harder to counterbalance. This interpretation is compliant also with the relevance of financial education transmitted by parent in ameliorating the credit card repayment.

#### *4.1. Interaction effects*

The results thus far have provided very useful information in the advancing the understanding of the relationship between financial (il)literacy and personality traits into credit card repayment decisions. However, the relationships may also be shaped by the presence of interaction effects deriving from Financial (il)literacy and the behavioral or personality variables. As noted, we uncover that personality traits are dominant in the decision individuals

make, particularly overspending (+) and Financial Education deriving from parents (–). In this context, and given the strong interest in the effects that financial (il)literacy may have on financial decision making, we proceed to compute and report the alternative models including interaction effects between Financial (il)literacy and financial education from parent and all four behavioral variables. The results are presented in Tables 6, 6a, and 6b, for Correct, Incorrect (Level A), and DNK (Level B), respectively.

The first set of estimations in Table 6 corresponds to the Financial Literacy-Correct answering sample. In these estimations, we observe that all previous results hold, overspending having a negative effect and worsening repayment, increased the number of credit cards also worsening repayment. FEPAR has a significant effect improving credit card repayment when the level of financial literacy is low whereas higher financial literacy resulting in better repayment patterns and lower chance of accumulation month-to-month debt when students did not receive financial education from their parents. In addition, the interaction effect of Financial Literacy and FEPAR has a positive and statistically significant coefficient: when students receive education from parents the positive effect of financial literacy disappears. Notice also that the Akaike information criterion (AIC) for the interaction model is lower than the corresponding model in Table 5 without the interaction. This is to say that the interaction model specification is preferred. In addition, none of the other interaction effects prove to be statistically significant, and therefore the models are inferior.

For the second set of interaction models, reported in Table 6a, for the Level of Financial Illiteracy Type A, we also observe results that are in accordance to the estimations reported in Table 6. However, under the interaction effect Model 1, the level of FEPAR is now not statistically significant, despite holding the expected sign. When the financial illiteracy is low the role of financial education from parents is not significant in improving the credit card repayment. The increase in the number of total incorrect answers results in credit card repayment worsening. When we interact Financial illiteracy and education from parent the coefficient is negative and statistically significant the 5% level of confidence. Our intuitive interpretation of this effect is that for student characterized by high level of financial illiteracy the education received from parents is fundamental in improving the credit card repayment. Notice that as it was the case for the Financial Literacy models, all other interaction effects are not statistically significant and the AIC values are also higher. We argue that the Model 1 is the preferred model.

For the third estimations, where Financial Illiteracy is measured through DNK answers (Table 6b), we observe that the interaction effects model for FEPAR and Financial Illiteracy Level B is significant and holds a negative sign. Our intuitive rationale for the coefficient in this model is that students that mainly answered DNK are able to improve their credit card repayment habits if they received proper financial education from parents. In addition, it is relevant to point out that the Financial Illiteracy coefficient is not statistically significant (as it was in Model 3.1–Table 5), but it now present a reversal of sign. In addition, the AIC for Model 1–Table 6B is lower than the corresponding model in Table 5, without interaction effects. Thus, we preferred the interaction model specification in this regard. As it was with other models, interaction effects for all other variables are not statistically significant. Our findings do not confirm completely Hypothesis 5. We do not detect that positive effects from higher levels of financial literacy could be overpowered by personal traits. Furthermore,

Table 6 Consumer behavior with credit card repayment frequency as dependent variable (Correct answers)

	Correct answers models with interaction effects				
	1	2	3	4	5
Financial educ parents	-2.145 (0.001)***	-0.934 (0.001)***	-0.936 (0.001)***	-0.927 (0.001)***	-0.939 (0.001)***
Anxiety	0.125 (0.24)	0.238 (0.40)	0.140 (0.18)	0.144 (0.17)	0.144 (0.17)
Surprised	0.120 (0.37)	0.135 (0.31)	0.147 (0.27)	0.395 (0.13)	0.144 (0.28)
OverSpending	0.577 (0.001)***	0.533 (0.001)***	0.439 (0.10)*	0.528 (0.001)***	0.530 (0.001)***
NCC	0.171 (0.06)*	0.162 (0.08)*	0.155 (0.09)*	0.167 (0.07)*	0.081 (0.75)
Financial literacy questions					
Total answers	-0.410 (0.001)***	-0.086 (0.67)	-0.174 (0.11)	-0.042 (0.75)	-0.191 (0.21)
Interaction effects of financial literacy with					
Parents financial education	0.428 (0.02)**	-0.032 (0.72)			
Anxiety			0.035 (0.69)		
Overspending					
Surprised				-0.097 (0.26)	
NCC					0.026 (0.73)
Obs	158	158	158	158	158
Pseudo R <sup>2</sup>	0.227	0.209	0.209	0.213	0.209
LR statistic	70.692	65.192	65.223	66.346	65.175
Probability (LR stat)	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
Akaike info criterion	1.651	1.685	1.685	1.678	1.686
Schwarz criterion	1.844	1.879	1.879	1.872	1.879
Hannan-Quinn criterion	1.729	1.764	1.764	1.757	1.764

Note: \*\*\*, \*\*, \* statistically significant at the 1%, 5% and 10% level, respectively.

Table 6a Consumer behavior with credit card repayment frequency as dependent variable (Incorrect answers)

Financial illiteracy Level A	Incorrect answers models with interaction effects				
	1	2	3	4	5
Financial educ parents					
Anxiety	-0.283 (0.45)	-0.940 (0.001)***	-0.922 (0.001)***	-0.942 (0.001)***	-0.919 (0.001)***
Surprised	0.132 (0.20)	0.222 (0.13)	0.149 (0.15)	0.163 (0.11)	0.160 (0.13)
OverSpending	0.142 (0.25)	0.149 (0.23)	0.144 (0.24)	-0.051 (0.79)	0.146 (0.23)
NCC	0.537 (0.001)***	0.506 (0.001)***	0.612 (0.001)***	0.498 (0.001)***	0.488 (0.001)***
Financial literacy questions					
Total answers	0.185 (0.02)**	0.164 (0.04)**	0.154 (0.05)**	0.167 (0.04)**	0.271 (0.01)***
Interaction effects of financial literacy with					
Parents financial education	0.530 (0.001)***	0.348 (0.21)	0.280 (0.04)**	0.076 (0.63)	0.368 (0.03)**
Anxiety	-0.434 (0.05)**	-0.054 (0.60)			
Overspending					
Surprised			-0.061 (0.45)		
NCC				0.123 (0.22)	
Obs	156	156	156	156	-0.080 (0.16)
Pseudo R <sup>2</sup>	0.223	0.213	0.213	0.216	0.215
LR statistic	69.172	65.870	66.050	66.981	66.590
Probability (LR stat)	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
Akaike info criterion	1.671	1.692	1.691	1.685	1.688
Schwarz criterion	1.867	1.888	1.887	1.881	1.883
Hannan-Quinn criterion	1.751	1.772	1.771	1.765	1.767

Note: \*\*\*, \*\*, \* statistically significant at the 1%, 5%, and 10% level, respectively.

Table 6b Consumer behavior with credit card repayment frequency as dependent variable (Do Not Know answers)

Financial illiteracy Level B	Do Not Know answers models with interaction effects				
	1	2	3	4	5
Financial educ parents					
Anxiety	0.183 (0.09)*	0.130 (0.37)	0.167 (0.12)	0.163 (0.12)	0.165 (0.12)
Surprised	0.147 (0.27)	0.180 (0.16)	0.185 (0.15)	0.184 (0.28)	0.184 (0.15)
OverSpending	0.519 (0.001)***	0.510 (0.001)***	0.551 (0.001)***	0.509 (0.001)***	0.504 (0.001)***
NCC	0.130 (0.15)	0.136 (0.13)	0.138 (0.13)	0.134 (0.14)	0.108 (0.34)
Financial literacy questions					
Total answers	0.275 (0.20)	-0.106 (0.71)	0.023 (0.89)	-0.018 (0.93)	-0.098 (0.69)
Interaction effects of financial literacy with					
Parents financial education					
Anxiety		0.041 (0.74)			
Overspending					
Surprised			-0.073 (0.61)		
NCC				-0.003 (0.98)	
Obs	156	156	156	156	0.046 (0.70)
Pseudo R <sup>2</sup>	0.209	0.198	0.198	0.197	0.198
LR statistic	64.674	61.214	61.359	61.101	1.722
Probability (LR stat)	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
Akaike info criterion	1.700	1.722	1.721	1.723	1.722
Schwarz criterion	1.896	1.918	1.917	1.918	1.917
Hannan-Quinn criterion	1.779	1.802	1.801	1.802	1.801

Note: \*\*\*, \*\*, \* statistically significant at the 1%, 5%, and 10% level, respectively.

financial knowledge derived from parents has a strong positive effect on individuals' financial behavior especially for people characterized by a relevant financial illiteracy.

Based on the findings from the interaction effects models, and the corresponding superiority of Models 1, in Tables 6, 6a, and 6b, we decided to use these series of models to compute the marginal effects and corresponding Probabilities. We present the overall probabilities for each model in Table 7, followed by the computation of the marginal changes in the overall probabilities when the independent variables change by one unit. It is also relevant to note that the estimated probabilities are computed at the mean value of the independent variables. For the especial case of the FEPAR variable (dummy 1,0) we compute the marginal effects by taking the difference between the overall probabilities when  $FEPAR = 1$ , minus  $FEPAR = 0$ .

There are several interesting results that spring out the analysis of Table 7. For instance, the first element to notice is that all probabilities are very similar across alternative models of financial (il)literacy with the probability to paying in full being in the range of 67.27 (DNK answers – Level B) to 68.82% (Incorrect answers – Level A), with 67.55% (Correct answers). And the rest of probabilities being almost identical for the other ranges across models. In other words, when evaluated at the mean values, we observe very little discrepancies across alternative models, when the only difference is based on the level of financial (il) literacy. This result on itself is surprising, as one would expect that different levels of financial (il)literacy would yield much larger differences in repayment patterns.

Secondly, when we look at the changes in probabilities due to variations in RHS variables, we now observe potentially large differences across models. The first effect to study here is that of FEPAR. Notice that the effect of this dummy variable has a significant marginal effect on the probability of repaying in full and has the largest effect of all variables. In this sense, we also observe that those suffering the most from Level B financial illiteracy are the group that would benefit the most with an increase learning deriving from their parents. The counter result indicates that those suffering from Level A financial illiteracy would still benefit from further interaction with their parents as the main source of financial literacy but with the smallest effect among the three possible groups. In addition, the counter result of variations in the FEPAR variable indicate that both Level B Financial Illiteracy and those answering correctly would be the groups that would suffer the most in their repayment capabilities should FEPAR were not to be the main source of financial literacy as reflected by the negative sign of the probability changes for the remaining categories.

The fourth element that we pay attention in this analysis is the effect of changes in the level of overspending. In this case, we observe that changes in overspending have the second largest effect of all variables. More specifically, an increase of one unit in overspending (following the stated categories in the descriptive statistics) have a negative effect in repayment capabilities of about 20% decrease in repayment in full; and incidentally an increase in all other repayment categories with paying less than full balance every month being the most affected. In this sense, a marginal change in overspending patterns, results in a large increase in month-to-month debt accumulation and falling behind in repayment patterns. Furthermore, this negative effect is larger than an increase in financial literacy as we will discuss next.

Financial literacy has been championed as the main way to improve financial decision-making process, and specifically research studying credit card debt emphasize on its

Table 7 Probabilities and marginal effects, for model with interaction effects

	Prob (y = 1 x)/∂P1/∂x	Prob (y = 2 x)/∂P2/∂x	Prob (y = 3 x)/∂P3/∂x	Prob (y = 4 x)/∂P4/∂x
Financial literacy model	67.55%	19.67%	7.69%	5.09%
Parents financial educ	0.313	-0.116	-0.091	-0.106
Over spending	-0.207	0.087	0.060	0.060
NCC	-0.061	0.026	0.018	0.018
Correct answers	0.147	-0.062	-0.043	-0.043
Interaction effect	-0.154	0.064	0.045	0.045
Level A - Financial illiteracy	68.82%	19.14%	7.32%	4.72%
Parents financial educ	0.295	-0.055	-0.085	-0.095
Over spending	-0.190	0.082	0.055	0.053
NCC	-0.065	0.028	0.019	0.018
Incorrect answers	-0.187	0.081	0.054	0.052
Interaction effect	0.154	-0.067	-0.044	-0.043
Level B - Financial illiteracy	67.27%	19.25%	7.84%	5.64%
Parents financial educ	0.348	-0.120	-0.098	-0.130
Over spending	-0.187	0.075	0.054	0.059
NCC	-0.047	0.019	0.013	0.015
Do Not Know answers	-0.099	0.040	0.028	0.031
Interaction effect	0.198	-0.079	-0.057	-0.062

Source: Marginal effects only reported for Model 1 Table 6, 6a, and 6b. y = 1 refers to pay in full, y = 2 refers to pay less than full but more than minimum, y = 3 refers to pay minimum, and y = 4 refers to pay less than minimum.



importance. While we do not dispute the inner importance of financial literacy in improving decision making, our results indicate that financial literacy plays a secondary role, when controlling for individuals' personality traits and consequent behavior. In particular, marginal effects analysis from Table 5, indicate that an increase in the number of correct answer in the financial literacy questionnaire result in a positive improvement (pay in full) in repayment patterns on the approximate amount of 14.7%. While a significant improvement, this amount is not enough to counterbalance the negative effects of behavior. By the same token, the negative effect of increased financial illiteracy is decomposed in a worsen repayment capability (away from full repayment every month) of 18.7% for Level A and 9.9% for Level B. It is relevant to point out that those overestimating their financial knowledge, yet answering incorrectly, are at the highest risk of falling behind and carry a month-to-month balance. In addition, it comes as a relative surprise that those suffering from Level B illiteracy are less likely to carry an increase negative probability of repayment in full when answering more DNK to the financial literacy questions. In this context, it becomes evidence that individuals with a lack of financial literacy Level A and personality traits dominated by overspending are highly more likely to fall behind, as reflected by the estimated values of the Prob  $y = 2, 3,$  and 4 categories.

A generalization of the results also indicate that the estimated probabilities and corresponding marginal effects are lower for the Level B financial illiteracy individuals than the other two groups. For Level B, it appears that they benefit the most from increased interaction with their parents (FEPAR), and recur less to more credit cards and consequently have a lower negative effect on repayment as the number of credit cards is increased. Thus, it appears that not knowing about financial literacy (DNK) makes them act in a more cautious way in relation to credit card use.

Furthermore, the robustness of the personality traits manifestation in the form of overspending are statistically consistent across all estimated models. In this context, it is more relevant to note that the estimated marginal effects of changes in this behavioral variable are also consistent even after controlling for the different levels of financial literacy and financial (il)literacy Levels A and B. In other words, our estimated probabilities and related marginal changes of increases in overspending seem to be independent of financial literacy. This result, as far as we are aware of, is unique and not present in the extant literature. As such, we argue that financial literacy has a limited impact on modifying personality traits and related behavior. It appears, that early intervention and an increase in financial literacy at early stages in life, primarily through parental education, may have the largest offsetting effects to personality traits leading to poor financial decision making.

## 5. Conclusions

The empirical evidence in this paper demonstrates that financial behavior, measured in terms of credit card repayment patterns, is affected more by personal traits than by financial literacy. This is to say, that financial decisions are made mainly based on personal traits or behavioral factors. Behavioral variables, such overspending, drive the accumulation of credit card debt and result in less than optimal repayment. Financial knowledge derived from

parental interaction with children seems to be the form of financial knowledge most relevant in positively influencing credit card repayment. Individuals with self-assessed lower level of financial literacy (DNK answers) display diverse behaviors (credit card repayment patterns) as opposed to individuals who do not possess basic financial literacy (wrong answers) even after controlling for cognitive or personal trait factors.

In our context, it appears that financial literacy has a limited positive benefit in shaping financial decisions. Previous evidence is mixed on this specific issue: although there is ample evidence supporting that higher financial knowledge translate into less risky credit card use (Norvilitis et al., 2006; Robb, 2011; Shim et al., 2009, 2010), other researches have reported greater financial knowledge was associated with lower fear about using credit cards and greater levels of debt (Borden et al. 2008; Lyons & Rogers, 2004; Robb & Sharpe, 2009). One possible explanation for these mixed results could depend on how financial knowledge is operationalized and measured. For instance, our study levers up the traditional financial literacy questions developed by Lusardi & Mitchell (2014) while Robb (2011) uses a financial knowledge score specifically designed to uncover specific knowledge about credit card use. Different results could be related to imprecise measurement of a latent variable such as financial knowledge.

Results from the parsimonious model specification also indicate the presence of robust behavior patterns along personality traits. Present-bias behavior, overconfidence and lack of control seem to be the main drivers of credit card use, and consequently of credit card repayment.

Now, with the existent data, we can measure the impact of behavioral differences while controlling for financial (il)literacy, but we cannot measure the possible gains in behavioral actions/responses due to increases in financial literacy. It is important to acknowledge this caveat in our study to both avoid incorrect data interpretation, and to set the future research agenda as we move forward. In essence, the long-term goal of the financial education or literacy movement is to provide mechanisms to positively affect economic behavior that currently result in costly and inefficient financial decisions. This is so, as financial behavior is highly determined by preferences, and these preferences may or may not be a function of financial literacy. If financial literacy does affect individuals' preferences and decision-making processes then one would expect that higher levels of financial literacy result in a series of benefits such as: increased saving, wiser investment decisions, lower to no month-to-month credit card debt, higher wealth accumulation, and higher retirement savings. Our findings are useful for policy makers to implement policies able to avoid, or reduce, debt trap and socio-economic vulnerability of the borrower. For instance, it appears that early intervention in terms of financial education may provide the necessary means to control endogenous costly personality traits. Once the personality trait has fully developed alternative means of positively impacting financial decision making might need to be implemented. As Xiao et al. (2011) highlight, financial education programs should target the multiple psychological processes that lead to changes in attitude and the enhancement of self-confidence, that is, they should target and develop students' positive financial intentions.

Finally, while being outside the scope of this study, further research on the subject of financial anxiety and its relation to credit card behavior will need to be explored, particularly the determination of the causality between credit card repayment habit and financial anxiety.

The tentative hypothesis states that higher financial anxiety should result in worse credit card repayment; thus, future research could analyze in more depth the role of psychological aspects and personality traits, in particular financial anxiety, in the process of financial decision-making, that is the possibility and cause-effect that higher credit card balance may fuel anxiety and result in a freeze effect where individuals may not improve repayment.

## Notes

- 1 In several studies, most individuals report having higher believed level of financial literacy than actual correct scoring on financial literacy questionnaire/surveys. See recent studies by GFLEC at George Washington University center for some examples (Almenberg et al., 2016).
- 2 In a recent papers Kim and Mountain (2019) suggest a specific statistical approach (binomial-latent regression models) to specifically tackle the issue of group differences that are hidden in DK/RF responses.
- 3 Aptitude is different from attitude: while attitude is a way of looking at an issue or an object, a mental position or way of thinking about an issue (in our case financial matters), the concept of aptitude is akin to natural or acquired talent or ability, inclination, predisposition. In this sense, aptitude for financial matters could be learn through financial education as reflected by higher levels of financial literacy.
- 4 The questionnaire has been successfully used to capture the financial literacy of diverse populations since it was first piloted in 2010 as part of the first OECD international financial literacy and financial inclusion measurement exercise. In 2018, an updated version was released that takes into consideration the changes in the financial landscape and the evolving state of knowledge; therefore, including questions related to digital financial services and crypto-assets, trust, integrity and financial consumer protection.
- 5 More recent studies have applied factor analysis (van Rooij, Lusardi, & Alessie, 2011). It is widely acknowledged, however, that more work, developed through rigorous psychometric analysis is needed (Bongini et al., 2015, 2016; Knoll & Houts, 2012).
- 6 For a comprehensive survey on personality psychology and economics the interested reader can refer to Almlund, Duckworth, Heckman, and Kautz (2011) and to Brown and Taylor (2014) for a specific application that analyzes the relationship between personality traits and financial decision-making focusing on unsecured debt and financial assets.
- 7 While the topics of “time value of money,” “inflation,” and “interest rate compounding” do represent basics knowledge to make informed choices when deciding to pay in full or accumulating a month-to-month balance, the issue of risk diversification is less strictly correlated.
- 8 Estimations for the NCC variables as the dependent variable, with demographic characteristics as RHS variables, are available from the authors upon request. We conducted the same estimations with demographics instead of NCC, and obtained

very similar results, without affecting the estimated coefficients of the other variables.

- 9 Recall that credit card repayment behavior is measured in a reverse scale, where the lowest value implies repayment in full, and higher values otherwise.

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