

BEYOND CONVENIENCE: THE COGNITIVE AND BEHAVIORAL BENEFITS OF CASH USAGE

Denaria Europe • July 2026

Abstract

While cash is often debated in terms of convenience and legality, this study uncovers its lesser-known cognitive, psychological, and developmental benefits. Drawing from neuroscience, behavioral economics, and pedagogy, we show that cash activates neural pain circuits that inhibit overspending, enhances budgeting skills through tangibility, and plays a foundational role in financial literacy for children. Through comparative frameworks and interdisciplinary research, we argue that eliminating cash may have unintended consequences for personal finance, education, and equity. These findings invite a reevaluation of physical currency in a digital-first economy.

Key Highlights

- Cash activates the insula, triggering a cognitive “pain of paying” that discourages impulsive spending.
- Cash enhances self-regulation and budgeting via tangibility, fostering cognitive and emotional control.
- Digital exclusion risks magnify when societies eliminate cash, affecting the elderly, poor, and neurodiverse.
- Children develop stronger financial literacy when they engage with physical money compared to digital equivalents.
- Cash has symbolic and ritual value, reinforcing social bonds (e.g., gifting, tipping, donations).

1. Introduction

In an era of rapid digital payment adoption and declining cash transactions, the use of physical currency is often seen as outdated or inconvenient. Indeed, according to recent global surveys, about two-thirds of adults worldwide made a digital payment in 2021 – a figure sharply up from just 35% in 2014 in developing economies, accelerated by the COVID-19 pandemic (World Bank, 2022). In many societies, tap-and-go cards, mobile wallets, and online payments have become the default. However, alongside the well-documented advantages of digital payments (speed, convenience, traceability), there is a growing body of interdisciplinary research highlighting lesser-known benefits of using cash. These benefits are grounded in psychology, neuroscience, behavioral economics, and even developmental science, suggesting that paying with tangible currency has unique effects on our brains, emotions, and financial behaviors that digital money does not replicate.

This paper provides an in-depth examination of these underappreciated benefits of cash, blending academic rigor with a consulting-style clarity. We explore how the physicality and immediacy of cash engage cognitive and emotional processes—such as the “pain of paying,” heightened ownership, budgeting discipline, and learning mechanisms—in ways that digital transactions do not. We draw on evidence from neuroeconomics (e.g., studies of brain activation during payment decisions), consumer psychology experiments, developmental research on children’s financial understanding, and behavioral economic theories. Our aim is to illuminate how cash, as a tangible medium of exchange, can influence spending behavior, self-control, and learning, ultimately impacting personal finance outcomes and consumer well-being on a global scale.

2. Cash and perceptions

2.1. Cash, the “Pain of Paying” and the value of tangibility

A core concept underpinning many benefits of cash is the so-called *pain of paying*. First coined by Ofer Zellermayer in 1996, the “pain of paying” refers to the negative affective response that people experience when parting with money (Zellermayer, 1996). In simple terms: spending cash “hurts” more than swiping a card or clicking “buy,” and this pain can curb spending (Prelec & Loewenstein, 1998). Handing over a physical bill or coin is psychologically akin to giving up something of value—triggering loss aversion and immediate awareness of expenditure (Hirschman, 1979). Digital payments, in contrast, often anesthetize this pain, as the outflow of money is less visible or is delayed (Feinberg, 1986;

Prelec & Simester, 2001). As we will see, the heightened *salience* and *immediacy* of paying in cash can act as a natural built-in check on spending, a feature now being recognized as a beneficial tool for financial self-regulation.

Beyond inducing prudent spending, the tangibility of cash fosters a sense of psychological ownership and value attachment. Behavioral studies have found that people perceive the same amount of money as more valuable when it is in cash form than in digital form (Zhou, Ye, & Liu, 2023). The physical experience of touching and seeing money leads to a stronger feeling that “this money is mine,” which in turn affects how carefully it is spent. We will explore how cash usage leads to greater awareness of one’s finances and can increase the perceived “purchasing power” of money. In fact, as we will discuss, consumers often prefer to receive money in larger-denomination bills precisely because it feels less “spendable”—a phenomenon known as the denomination effect (Raghubir & Srivastava, 2009). These subtle psychological differences mean that cash transactions carry more emotional weight: paying cash can evoke emotions like reluctance, sadness, or even guilt when spending, but also greater satisfaction and attachment to purchases afterward (Khan & Belk, 2024; Shah, Eisenkraft, Bettman, & Chartrand, 2016).

The distinctions between cash and cashless payments are not only behavioral but also neural. Recent neuroimaging studies reveal that paying with cash versus paying with cards or phones engages different brain circuits. When people handle cash, brain regions linked to aversion and pain—such as the insula—show higher activation, reflecting the emotional “sting” of parting with tangible money (Ceravolo et al., 2019). Conversely, when using credit or other cashless methods, this neural pain response is muted; instead, reward-related regions like the striatum (a dopamine hub associated with pleasure and craving) can become more active, effectively “stepping on the gas” of spending motivation (Banker, Dunfield, Huang, & Prelec, 2021). These findings offer literal evidence for the metaphor that credit cards anesthetize the pain of paying while possibly even heightening the allure of buying. We will delve into these studies to understand how the brain’s response to spending differs with cash, and why those differences might be harnessed as a form of self-control mechanism against overspending or impulsive purchases.

Additionally, an often-overlooked aspect is how the form of money impacts children’s cognitive development and financial education. Young children today are growing up in homes where money is increasingly abstract—numbers on a screen or taps on a phone—raising concerns that they may fail to grasp the value of money and budgeting basics. Researchers have noted that by around seven years of age, most children can

understand fundamental financial concepts like exchange and saving, and that early experiences with physical money can shape lifelong money habits (Whitebread & Bingham, 2013). We examine how using physical cash (e.g. giving a child cash for allowance or piggy-bank savings) provides concrete, hands-on learning that builds numeracy, delay of gratification, and the concept of limited resources. In contrast, purely digital money may be more challenging for children (and even teenagers) to conceptualize, sometimes leading to diminished “financial touch” – for example, studies report that many parents and educators believe digital transactions make it harder for kids to appreciate money’s value and can encourage more impulsive spending in youth. By drawing parallels to other domains of learning (such as the benefits of handwriting for memory), we highlight the importance of tangibility in teaching and reinforcing financial skills.

3. Scope and Approach

Throughout this paper, we maintain a global and interdisciplinary perspective. Evidence is drawn from peer-reviewed psychology and neuroscience experiments, consumer research in various countries, developmental studies, and financial behavior surveys. We also consider policy and practical implications: as societies weigh the push toward cashless economies, understanding these hidden benefits of cash is vital. The discussion will address how some of cash’s beneficial features might be preserved or emulated even in digital systems (for instance, through budgeting apps or “cash-mode” settings that introduce friction), and why preserving the option of cash in the payments landscape might support consumer well-being and financial responsibility.

In sum, cash is far more than just a payment instrument. It is also a powerful cognitive tool that shapes how we think, feel, and behave with money. The sections that follow will explore these themes in depth, beginning with the foundational question of how different payment methods affect spending behavior and why cash has earned its reputation as a brake on overspending.

3.1. Psychology of cash

A fundamental difference between cash and cashless payments lies in their *psychological impact at the moment of purchase*. Decades of research in behavioral economics and consumer psychology have demonstrated that the method of payment can significantly

influence how much people spend, how they feel about spending, and even what they choose to buy (Hirschman, 1979; Soman, 2001). The key mechanism often cited is the pain of paying – the immediate negative emotion or discomfort experienced when we part with our money. Cash, by its nature, tends to amplify this feeling, whereas credit cards and other digital forms soften it. This section examines classic and contemporary findings on how payment mode affects spending, highlighting why cash tends to encourage frugality and conscious spending while cashless methods can encourage higher expenditure.

One of the earliest empirical demonstrations of payment-method effects came from Elizabeth Hirschman (1979), who analyzed consumer behavior across different payment systems. She found that consumers using credit cards not only spent more on average, but also were more willing to make discretionary purchases compared to those using cash. This suggested that something about credit cards reduced the “friction” or hesitancy associated with spending money (Hirschman, 1979). Around the same time, marketing researcher Richard Feinberg conducted a series of experiments showing that simply exposing people to credit card cues (like a credit card logo in the room or on a catalog) could lead them to spend or tip more freely – as if the very presence of this payment symbol conditioned them to loosen their purse strings (Feinberg, 1986). These early findings introduced the idea that credit cards act as spending facilitators by decoupling the joy of consumption from the immediate pain of payment.

Dilip Soman (2001) provided a theoretical framework for these observations, emphasizing two key differences: payment coupling and payment transparency. In a cash transaction, payment is tightly coupled with the purchase – you physically hand over money at the exact moment you receive the product or service, making the cost highly salient. In contrast, credit cards (and even more so, mobile payments) decouple the timing and tactile experience of payment from consumption. The consumer enjoys the purchase now but won’t feel the financial loss until later (when the credit bill arrives), or at least doesn’t see the money leaving their hand. Soman’s experiments confirmed that when the act of payment is less immediate or less visible, people’s recall of expenditures diminishes and their willingness to spend increases (Soman, 2001). In one study, participants who paid by card were less able to remember exactly how much they had spent on a series of items, compared to those who paid by cash – a consequence of the reduced “rehearsal” of the payment amount and the lack of a physical cash outflow (Soman, 2001). This weaker memory and awareness can open the door to overspending because one does not fully register the cumulative losses.

Table 1. Behavioral and psychological differences between cash and cashless payment modes, based on research findings.

Aspect	Paying with Cash	Paying with Cards/ Digital
Salience of Spending	High – visible cash outflow signals a loss (immediate feedback of spending). <i>Example:</i> physically seeing your wallet emptied reinforces the cost.	Low – abstract transaction (swipe or click) provides little visual feedback. <i>Example:</i> bank balance changes number, often noticed later.
Pain of Paying	Strong “pain” – triggers loss aversion and hesitation, making spending feel more real (Prelec & Loewenstein, 1998; Ceravolo et al., 2019).	Weakened “pain” – transaction feels effortless or even “numb,” reducing psychic cost (Feinberg, 1986; Banker et al., 2021).
Willingness to Spend	Lower WTP (willingness to pay) – consumers often resist paying higher amounts in cash (Raghubir & Srivastava, 2008). They are also more price-sensitive and likely to put items back when cash runs low.	Higher WTP – consumers pay more and buy more items on average with cards. Studies show bids/prices offered can be 50–100% higher with credit than cash (Prelec & Simester, 2001).
Impulse Purchases	More restrained – the friction of cash can check impulsive buys, especially for “vice” products. One must consciously decide if a spontaneous purchase is “worth” the cash on hand.	Easier indulgence – frictionless payments encourage impulse buys (Thomas, Desai, & Seenivasan, 2011). Cards disconnect the visceral check, so people add extras to the cart or choose upgrades more readily.
Expense Tracking & Memory	Clear mental account – handing over cash and seeing less money remaining aids memory of expenses and budgeting (Soman, 2001). Many physically keep receipts or note cash spent.	Hazy account – with automated card records, people often rely on statements later. In-the-moment tracking is poorer; users tend to underestimate or forget spending (Hirschman, 1979; Soman, 2001).
Emotional Attachment	Higher attachment to money and to items bought – parting with cash feels like a personal loss, and items bought may feel “hard-earned,” increasing post-purchase care or satisfaction (Shah et al., 2016).	Lower attachment – spending digital money can feel like spending “someone else’s” money or just numbers, potentially reducing the personal value ascribed to what’s bought.

Table 1 summarizes some of the documented behavioral differences between using cash and using digital payment methods. One of the most striking demonstrations of how payment method affects spending was provided by Prelec and Simester (2001). They conducted an actual auction for event tickets with two randomly assigned groups of participants: one group was told they must pay in cash if they won, the other group would pay by credit card. Despite bidding on the identical item under the same conditions, the credit card group’s average bid was nearly twice as high as the cash group’s (Prelec &

Simester, 2001). In other words, people were willing to pay almost 100% more for the same product when using a card instead of cash. The authors titled their study “Always Leave Home Without It” (a play on a famous credit card slogan), underscoring the idea that leaving your credit card behind (and using cash) could constrain overspending. This “credit card premium” on willingness-to-pay has been replicated in various contexts. For example, Raghubir and Srivastava (2008) found that consumers faced with hypothetical purchases assigned higher spending budgets and were more prone to splurge when using less transparent forms of payment like gift certificates or scrip versus cash. In controlled lab settings, even when total wealth was the same, the mode of payment systematically skewed spending behavior – a testament to how the mind treats “money in hand” differently from abstract credit.

The payment transparency that cash provides – you hand over tangible value and your wallet immediately feels lighter – serves as a natural checkbook register and a self-imposed limit. One literally cannot spend more cash than one has on hand. With cards, the physical limitation is gone and the feedback is delayed, often until the end of the month when the bill arrives (or until one hits a credit limit). This delay can create what Prelec and Loewenstein (1998) describe as *decoupling* between consumption and payment, allowing the pleasure of buying to proceed relatively unopposed by immediate pain. Moreover, because a credit card transaction doesn’t require relinquishing something visible, it can feel as though one isn’t really spending “real money” – it’s more like an IOU to be dealt with later. Consumers themselves recognize this difference: surveys have found that many people admit they are “less concerned with price” or “more impulsive” when using credit cards compared to cash, even if they consciously know the money will leave their bank eventually (Banker et al., 2021). In effect, the illusion of liquidity and ease created by cards can trick our self-control mechanisms.

Importantly, it’s not only credit vs. cash that matters – even among digital payment methods, different levels of friction produce different outcomes. For example, contactless card payments (just tapping a card) have been reported to feel even less painful than inserting a card and entering a PIN, since the action is so quick and inconsequential. Mobile wallet payments (paying via smartphone apps) can be even more “invisible” – often just a scan or even an automatic deduction – further reducing the sensory cues that normally alert us to spending (Ma, Tan, He, & Wang, 2024). One recent investigation introduced the idea of a “*pleasure of paying*” with seamless methods: when the pain is nil, some consumers may actually derive a slight thrill or positive feeling from the ease of purchase, which in turn

reinforces the spending habit (Ma et al., 2024). This suggests that technology has the potential to not only remove the sting of payment but perhaps even condition our brains to enjoy the act of buying in a frictionless way, much like a quick dopamine hit.

From a broad perspective, these findings challenge the classic economic assumption that *how* you pay shouldn't affect *how much* you spend. In theory, a rational consumer would treat \$100 in cash or on a card the same; in reality, the format changes the consumer's behavior considerably (Soman, 2001; Runnemark, Hedman, & Xiao, 2015). In practical terms, the pain of paying in cash is a feature, not a bug. It injects a moment of deliberation and awareness at the checkout: "Do I really want to hand over these hard-earned bills?" That moment (however brief) can protect consumers from rash decisions and encourage budgeting. On the flip side, the muted pain of digital payments can lead to what some researchers call the "cashless effect" – difficulty budgeting and a tendency to overspend when using cards or electronic payments (Thomas et al., 2011). Notably, Thomas, Desai, and Seenivasan (2011) observed that shoppers buying groceries with credit cards purchased a higher proportion of unhealthy, impulsive items (like sweets and snacks) compared to cash buyers, presumably because the card users' self-control was less triggered by immediate payment concerns. This illustrates how the medium of payment can even influence *what* we buy, steering choices towards more indulgent options if the payment feels painless.

3.2. Individual Differences and Contextual Factors

It is worth mentioning that the pain of paying is not uniform for everyone or in every situation. Individual differences play a role: the *Spendthrift-Tightwad Scale* developed by Rick, Cryder, and Loewenstein (2008) categorizes people based on their sensitivity to payment pain. "Tightwads" feel intense pain from spending and will often go to great lengths to avoid purchases, whereas "Spendthrifts" feel too little pain and overspend. Interestingly, the payment method can modulate these tendencies. A tightwad might loosen up slightly with a gift card or credit (since the pain is dulled), whereas a spendthrift might impose self-restraint by using cash-only budgets to force more pain/awareness (Rick et al., 2008). In practice, many consumers intuit these effects: for instance, some people switch to a "cash diet" when they need to save money, precisely because they know using cash will constrain them more than cards. On the other hand, a habitual spendthrift may heavily favor cashless modes because the discomfort of cash spending is something they subconsciously avoid (Hirschman, 1979). The net effect is that cash tends to bring everyone

closer to the frugal end – it intensifies the pain for those who need it and serves as a conscious speed bump even for those already prudent.

Context also matters. When the stakes of spending are high (e.g., a very expensive purchase), even card users might feel significant pain, whereas for trivial amounts, even cash users might not hesitate. There can be boundary conditions: recent research by Liu and Dewitte (2021) and others has probed whether the pain of paying always mediates spending differences. Some studies found that at very low price levels, the difference between cash and cashless might diminish – low prices don't induce much pain either way (Ma et al., 2024). In contrast, at high price levels, the pain gap may widen; paying a large sum in cash (think buying a \$1,000 TV with banknotes) is viscerally daunting, whereas swiping a card for \$1,000, while not pleasant, still feels more abstract (especially if one focuses on the monthly installment or minimum payment). Ceravolo et al. (2019) noted in their fMRI study that the insula (pain center) was particularly sensitive to larger amounts when viewing cash payments – i.e., the more money being paid in cash, the more strongly those negative emotion areas fired. This scaling effect suggests that cash enhances sensitivity to amount: every additional dollar *feels* like an added loss, whereas in cashless forms one might become numb to the magnitude until later reflection.

Another context to consider is debt and credit behavior. The ease of card spending has been linked to greater likelihood of revolving debt and less controlled finances. Consumers using credit are more prone to underestimate their expenses and thus can be surprised by interest charges (Banker et al., 2021). In one analysis, households that primarily used cards had systematically higher outstanding debt and lower savings than those that primarily used cash or debit, even after controlling for income (Tokunaga, 1993). By contrast, using cash naturally forces a pay-as-you-go approach, avoiding the trap of spending beyond one's means. In behavioral terms, cash enforces a form of pre-commitment: you either have the money now or you don't spend it. Many financial counselors advise people struggling with credit card debt to switch to a cash-only regimen for daily expenses, precisely to regain awareness and control. Empirical studies support this advice – for example, a field experiment by Kamleitner and Erki (2013) found that participants instructed to use cash for a month experienced improved budget adherence and reported less impulse buying than their baseline habits with cards.

In summary, a robust body of evidence shows that cash exerts a restraining influence on spending through the psychological pain and salience associated with it, whereas cashless modes remove those brakes. This is not merely a behavioral quirk but can translate into

meaningful differences in financial outcomes (lower discretionary spending, less debt). The “pain of paying” thus emerges as a protective mechanism.

Having established how cash can influence spending behavior through psychological pain and attention, we will now turn to the neural underpinnings of these effects. What does modern neuroscience reveal about *why* cash feels different to the brain? The next section explores the emerging neuroeconomic evidence on payment methods, showing that the age-old adage “it *hurts* to part with your money” is more than just a metaphor – it has a literal basis in the brain’s pain and reward circuits.

4. Neural Correlates of Cash and Digital Payments

The advent of neuroimaging techniques in consumer research has opened a window into the brain’s response during spending decisions. If paying with cash indeed “hurts” more than paying by card, we might expect to see this reflected in neural activity associated with pain or aversion. Likewise, if credit cards spur spending by activating reward mechanisms (as behavioral evidence suggests), this too should appear in the brain’s reward centers. A number of pioneering studies in the last 15 years have examined the neural correlates of different payment methods, providing biological validation of concepts like the pain of paying and offering new insights into how payment form can modulate decision processes at a fundamental level. This section reviews key neuroscience findings, showing that the human brain reacts very differently to cash versus cashless transactions – differences that map onto the behaviors discussed earlier.

4.1. The Brain’s Pain and Reward Centers in Purchase Decisions

One landmark neuroeconomic study by Knutson, Rick, Wimmer, Prelec, and Loewenstein (2007) demonstrated that two brain regions work in opposition during purchasing: the nucleus accumbens (NAcc), a core component of the reward circuit, and the insula, a region implicated in pain and discomfort. In their experiment, participants inside an fMRI scanner were given money and presented with a series of products to potentially buy. The sequence was: see a product, see its price, then choose to purchase or not. Knutson et al. found that seeing a desirable product activated the NAcc (reflecting the anticipation of pleasure/reward at the thought of obtaining the item). However, when the price appeared, the insula was activated – especially if the price was perceived as too high. If the insula’s activity outweighed the NAcc’s (i.e., the pain of paying felt greater than the potential pleasure of the purchase), the participant typically decided not to buy the item. If the NAcc

activation (wanting) remained higher than insula activation (pain), the purchase was made. In essence, the brain was performing a real-time cost-benefit analysis: *reward vs. pain*, with the insula tipping the scale toward restraint when a price was aversive (Knutson et al., 2007). This study was notable because it provided *neural evidence* for the notion of the pain of paying and showed that it plays a causal role in purchase decisions. The insula, often associated with physical pain or disgust, was literally active when subjects contemplated spending money – suggesting that the brain treats spending as a negative experience to be avoided, much like touching a hot stove, unless counteracted by enough positive motivation for the item.

Importantly, Knutson et al.'s experiment involved participants using a fixed sum of cash in hand to buy items (the money was deducted from their endowment if they decided to purchase). Thus, it was essentially modeling a cash purchase scenario – the “payment” was immediately deducted from their experimental wallet. The authors noted even then that credit cards might blunt this insula response, since they “anesthetize” the paying pain (Knutson et al., 2007). They speculated that in a real credit card purchase, the insula might not activate as strongly because the immediate loss isn't registered in the same visceral way. This speculation has since been directly tested by newer neuroimaging studies comparing payment methods.

4.2. Cash, Card, or Smartphone: Different Brain Activation Patterns

A recent fMRI study by Ceravolo et al. (2019) explicitly examined brain activation when people observed transactions conducted in different forms: cash, credit card, and smartphone payments. In this study, participants in the scanner watched videos of a hand making a payment with either cash, a card, or a mobile phone for items of varying price (10€, 50€, 150€), while the researchers measured neural activity differences. The results were illuminating: viewing cash payments elicited significantly greater activation in the right insula and in parts of the parietal cortex (specifically, the supramarginal gyrus in BA40) compared to viewing card or phone payments, regardless of the amount (Ceravolo et al., 2019). The insula activation aligns with the notion that cash payments carry a higher affective “pain” or distress signal. The parietal cortex activation is also interesting – this region is involved in numerical processing and the planning of motor actions; the authors suggested it might reflect the brain's heightened engagement in evaluating the utility of the action (handing over cash) and the magnitude of loss. In other words, paying with cash made the brain work harder to process “what am I giving up?” than paying by card, which was processed in a more perfunctory manner.

Ceravolo and colleagues also found that the difference became even more pronounced at higher amounts: for the large 150€ payments, cash triggered not only insula and parietal activity but also the posterior cingulate cortex (PCC) – an area related to emotional evaluation and memory – to a greater degree than digital payments did (Ceravolo et al., 2019). This suggests that a big cash payment is a salient, emotionally charged event for the brain (perhaps being encoded strongly into memory), whereas a big digital payment, while not free of impact, doesn't light up those same circuits as intensely in the moment. The authors concluded that *"cash enhances the salience and negative affective valence of parting with money,"* and they went further to propose that *"cash payment could represent a stronger self-regulating tool"* for consumers prone to overspending (Ceravolo et al., 2019, p. 329-332). In plain terms, the brain's response indicates that paying in cash feels more like *giving something up*, which naturally can help one regulate spending by injecting caution or even discomfort into the act of purchase.

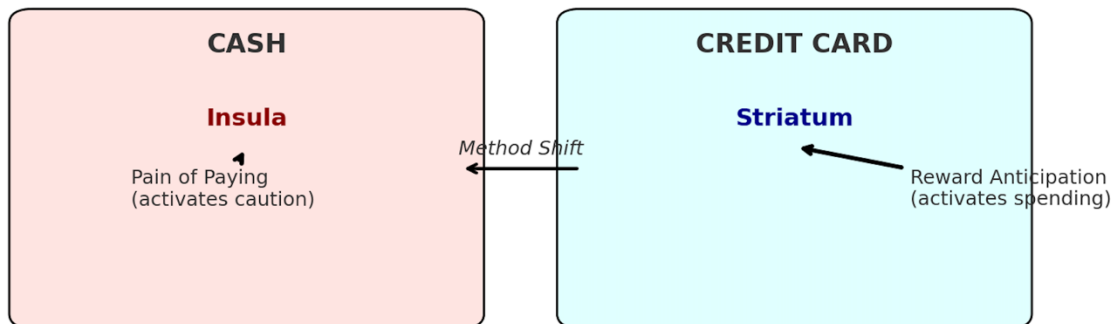
On the other side of the coin (so to speak), what about reward circuitry? If cash is tuned to pain, are cards tuned to pleasure? Research led by Banker et al. (2021) suggests that indeed, credit card spending might engage the brain's reward systems in a way that cash does not. In a study published in *Scientific Reports*, participants performed purchase decisions under two conditions while undergoing fMRI: using a limited budget of cash vs. using a credit card (with the same spending limit). The design allowed them to see how the brain differed when contemplating a purchase depending on payment mode. The striking finding was that when participants were in "credit card mode," there was significantly greater activation of the striatum, particularly in regions associated with reward anticipation and habit conditioning, compared to when they were in "cash mode" (Banker et al., 2021). The striatum (which includes the nucleus accumbens highlighted earlier) is known to release dopamine and is involved in learning behaviors that are rewarded. Its activation suggests that credit card use can actually condition the brain to feel good or excited about the act of purchasing, potentially reinforcing the desire to spend. Meanwhile, the insula activation did not differ significantly between credit and cash in that study (Banker et al., 2021), which was initially puzzling given expectations. However, the authors interpreted this as evidence that credit cards primarily work by *increasing reward response ("stepping on the gas")* rather than by completely eliminating all pain. In their experiment, insula responded to high prices in both cases (some pain still registers even if paying by card), but the key difference was that credit card cues boosted striatal activity – effectively drowning out the pain signal with a stronger temptation or desire to buy.

These neural results dovetail with the behavioral patterns observed. If credit card spending repeatedly activates reward pathways and provides immediate gratification (getting the item) with minimal immediate aversion, over time a consumer could become conditioned to spend in a manner analogous to an addiction (Prelec & Loewenstein, 1998; Banker et al., 2021). The analogy might sound extreme, but consider how casinos design slot machines: lots of cues and lights to stimulate reward feelings, and the use of tokens or digital credits instead of cash precisely to reduce the friction of betting. Similarly, credit cards and now mobile in-app purchases create an environment where the “hit” of acquiring something new is front-loaded, and the cost feels distant or invisible, potentially leading to a cycle of craving and spending. In fact, Prelec and colleagues in the MIT study noted that the brain’s reward center (the same one exploited by drugs like cocaine) showed sensitivity to prior credit card use experiences – implying people develop a learned anticipatory excitement when they even see a credit card or a “Buy now” button, because they subconsciously associate it with the reward of shopping (Banker et al., 2021). This chronic sensitization of the reward network could manifest as a spending habit that is hard to break, especially in vulnerable individuals.

By contrast, cash payments did not produce such reward surges. In Banker et al.’s work, purchases made with cash elicited much weaker striatal activation and were mainly associated with lower-priced items; higher-priced items were often rejected when paying with cash, consistent with the stronger inhibitory signals present (Banker et al., 2021). Thus, while credit cards may metaphorically “step on the gas” for spending, cash tends to “ride the brakes,” at least at a neurological level. The absence of a big dopamine rush when handing over cash means the act of purchasing stays more purely a cost to the brain, something one might not so eagerly seek to repeat unless truly necessary or worthwhile.

To visualize these differences, consider Figure 1, which illustrates the simplified neural response profiles for cash vs. credit card spending based on the discussed studies.

Figure 1: Conceptual comparison of neural activation during cash vs. credit card purchases – Cash transactions elicit higher activation in the insula (“pain of paying”), while credit card transactions elicit higher activation in the striatum (reward anticipation). These neural patterns align with cash triggering caution and cards encouraging additional spending.



Neuroscientific evidence thus reinforces the behavioral data: cash and cashless payments are processed differently in the brain, engaging distinct emotional and motivational circuits. Paying in cash more strongly engages regions associated with negative feelings, conflict, and self-reflection on value (insula, cingulate, parietal areas), which likely contributes to more restrained decision-making. Paying by card triggers relatively less of those negative signals, and can even engage positive reinforcement circuits (striatal dopamine pathways) that encourage spending. It’s a literal case of “no pain, no gain” – when there’s no pain signal, the brain only sees the gain (the product, the reward), so it’s more inclined to go forward with the purchase.

These findings have practical implications. They suggest that people struggling with compulsive buying or gambling might benefit from using cash as a form of “therapy,” forcing the brain to feel the weight of each transaction (Ceravolo et al., 2019). Indeed, Ceravolo et al. noted that their results could be relevant for *regulating compulsive shopping or digital gambling*, since the heightened emotional engagement from cash might deter excessive behavior. Conversely, the research also flags a caution: as we move into increasingly frictionless payments (contactless, one-click ordering, etc.), we might be removing natural neurocognitive checkpoints that ordinarily help people self-regulate (Prelec & Loewenstein, 1998; Banker et al., 2021). Policymakers and designers of payment systems could consider ways to incorporate some feedback or “speed bumps” in digital payments—some banks and apps have begun doing this by sending instant notifications or requiring a confirmatory swipe for large purchases, to introduce a moment of awareness akin to seeing cash leave one’s hand.

Another nuance from recent neural research is the concept of price-level contingent effects. As mentioned earlier, a study by Qingguo Ma et al. (2024) found that for high-price

purchases, the pain of paying (insula-mediated) clearly plays a mediating role in why mobile payments lead to more spending—because with mobile pay the pain is low, so people spend more at high prices. However, for lower price purchases, the difference in pain might not fully account for extra spending; instead they identified an implicit “pleasure of paying” mechanism. In their experiment, at low price points, mobile payment users paid more not because they felt less pain (it was already low for cheap items for everyone) but because they paid *more attention to positive product attributes*, indicating a subtle shift in mindset toward the benefits and away from costs (Ma et al., 2024). This suggests digital payments might not only remove negative feelings but also tilt cognitive focus toward the rewarding aspects of a purchase (what one is getting) rather than the loss (what one is giving up). In neuroscience terms, one might say the **** salience network**** in the brain is re-weighted: cash makes the cost salient; digital makes the reward salient.

In summary, neuroscience confirms a critical point: using cash vs. using digital money are not neutral, equivalent actions in the brain. They are associated with different affective and cognitive neural signatures, which help explain the behavioral patterns observed. The brain’s response to spending money is malleable depending on how tangible that spending is. Cash makes the spend feel real to the brain, recruiting circuits that encourage a pause or a stop signal. Card and digital payments can short-circuit those stop signals and even press on go-signals (reward) in the brain. Understanding these mechanisms underscores why the disappearance of cash could have unseen consequences on consumer behavior. It also highlights the genius of something as simple as paper money: by engaging multiple senses and emotional responses, cash naturally integrates a form of negative feedback into every financial decision.

The next sections will move from the neural and behavioral to the psychological and social dimensions. We will explore how the tangibility of cash fosters psychological ownership and value perception, and how that in turn affects budgeting, saving, and even personal happiness with purchases. We’ll also examine how these effects extend to broader cognitive and educational contexts – for instance, drawing parallels to how physically writing by hand affects learning, as an analogy for why physically handling money might influence financial cognition. The rich interplay between mind, brain, and money highlights cash’s role not just as a payment tool, but as a kind of “training weight” for our financial discipline and understanding.

5. Tangibility and Psychological Ownership: Why Money You Can Touch Feels Different

One of the most profound advantages of cash lies in its tangibility – you can see it, hold it, count it. This physical presence imbues cash with a sense of reality that purely digital forms of money often lack. Psychologically, this manifests as a stronger feeling of *ownership* over cash and a clearer notion that “this is my money.” In turn, this heightened psychological ownership influences spending behavior and value perception. In this section, we discuss how cash’s tactile nature fosters greater awareness of value, alters consumer decision-making, and even increases the emotional attachment to both money and purchases made with it.

5.1. “This Money Feels Real”: Perceived Value and Purchasing Power

Imagine you have \$50 in your wallet as a single \$50 bill versus as five \$10 bills. Many people report that breaking a \$50 bill to make a purchase causes more hesitation than spending a \$10 bill out of five – even though economically it’s the same amount. This is a common experience and is directly related to what researchers call the denomination effect (Raghubir & Srivastava, 2009). In their study, Raghubir and Srivastava found that individuals given an amount of money in one large denomination were less likely to spend it than those given the equivalent in many smaller denominations. For example, in one experiment, only 26% of participants given a \$1 bill chose to spend it on candy, whereas 63% of those given four quarters (also \$1 total) spent the money (Raghubir & Srivastava, 2009). The larger bill was seen as more valuable and thus was conserved – psychologically it was “worth more” than the sum of coins even though the face values were equal. The authors argued that larger denominations are perceived as less fungible (less easily exchangeable) and thus people treat them more preciously. Many participants even reported that they preferred receiving money in a large single chunk (like a \$100 note) if they wanted to save, versus in smaller units if they intended to spend, indicating a tacit knowledge of this effect (Raghubir & Srivastava, 2009).

This denomination effect illustrates a broader point: cash makes the value of money salient and concrete. When you hold a \$50 bill, it often feels like a significant sum; you might subconsciously earmark it for something important, whereas fifty dollars in a bank account or as a number on a screen might not evoke the same sense of substantial value. The act of physically partitioning money (into envelopes, jars, or simply different denominations) is a common budgeting tactic precisely because it exploits these psychological perceptions – it

creates mental “buckets” of funds that people are more reluctant to breach. Digital money, in contrast, is highly fungible and fluid; \$50 is just an abstract figure, easily sliced and diced by software or mental accounting without the gut feeling of value that a tangible \$50 bill carries.

Empirical research by Zhou, Ye, and Liu (2023) put this intuition to the test and confirmed that cash increases perceived purchasing power (PPP) relative to digital money. In a series of experiments, they asked participants to imagine having a certain amount either in cash or in a digital account and then measured their perception of how much that money could buy. Consistently, those who imagined the money in cash form felt it could buy more – as if the cash was “worth more” – than those who imagined it digitally (Zhou et al., 2023). Mediation analysis showed that this effect was driven by psychological ownership and psychological distance: cash engendered a stronger immediate sense of ownership (“this money is mine right here and now”), and it reduced psychological distance (the money felt closer and more concrete). Digital money, even if technically owned by the person, felt more distant or intangible, thus slightly less valued in terms of what it could do. This subtle shift in perceived purchasing power can influence spending restraint. If \$50 in cash feels like a lot of money, you might be less willing to drop it on a trivial purchase; if \$50 in an app feels like just a number, you may be more willing to spend it impulsively, underestimating its true value.

The visceral experience of cash also forces continuous valuation. Every time you open your wallet and see the bills, you reassess how much you have left and what it’s worth. People often report that paying in cash makes them “feel the expense” more keenly – an anecdotal reflection of stronger psychological ownership and loss aversion kicking in. In focus group studies across different cultures (e.g., New Zealand and China), consumers have expressed that with cash, “it always feels like *your* money is decreasing when you use it,” whereas with digital payments, “there is no concept of money” – it doesn’t *feel* like spending one’s own money in the moment (Khan & Belk, 2024, p. 72-75). This quote from Khan and Belk’s qualitative research captures a common sentiment: cash is tangible and finite; digital money can feel almost imaginary or separate from oneself.

5.2. Emotional Attachment and the Endowment of Cash

Physical interaction with money doesn’t just alter perceptions of value – it also affects emotional attachment. Psychological ownership is the feeling that something is “yours,” and it tends to grow with tangible interaction. Just as physically touching or using a product

can increase one's attachment to it (a well-known effect in consumer research), physically holding money can heighten one's attachment to that money. If we feel more ownership over our cash, spending it is emotionally harder because it's akin to losing a part of what we own. In contrast, digital transactions can create a sense of detachment – the money was never *in our hands*, so relinquishing it is less poignant.

A study by Jashim Khan and Russell Belk (2024) delved into consumers' emotional experiences with cash versus cashless payments. Using interviews and open-ended surveys, they found that cash usage elicited rich emotional descriptions: people spoke of cash with words like “security,” “comfort,” and even described parting with cash as “parting with a piece of ourselves” (Khan & Belk, 2024). The tactile sensations – the smell of paper money, the act of counting bills – reinforced the reality that this was *their* resource. Some participants noted feelings of sadness or guilt when handing over cash, but interestingly, these emotions were associated with greater reflection and sometimes better decision-making (“Do I really need this?” moment of pause). On the other hand, those describing digital payments often mentioned how *easy* and impersonal it was: “just numbers changing” or “like playing with Monopoly money” were common themes. They admitted that ease gave a sense of happiness or convenience initially, but later could lead to regret because they spent without feeling it (Khan & Belk, 2024). In essence, cash transactions carry more emotional weight – a weight that may feel burdensome at the point of purchase (hence discouraging spending), but can translate into greater satisfaction or at least consciousness about where one's money went.

This emotional aspect of cash is further illustrated by the work of Shah et al. (2016). They investigated how the form of payment influences the post-transaction connection between consumers and their purchases. The study titled “Paper or Plastic? How We Pay Influences Post-Transaction Connection” found that people who paid for an item in cash reported feeling more attached to and more satisfied with the item later on, compared to those who paid by card (Shah, Eisenkraft, Bettman, & Chartrand, 2016). The reasoning is that because paying in cash is more painful and requires a more vivid sacrifice, the consumer subconsciously values what they bought *more*, to justify the pain endured (a form of effort justification). In one experiment, participants purchased a coffee mug either by cash or by credit voucher; those who paid cash not only valued the mug higher afterward (greater willingness-to-accept to give it up) but also remembered more details about it and expressed more affection for it (Shah et al., 2016). The act of handing over physical money created a moment of “ownership transfer” where the money was truly *given up* and the item

became truly *theirs*, strengthening the bond. In contrast, paying by voucher (or credit) was more frictionless, and thus the post-purchase connection was weaker; it was easier for those participants to later part with or undervalue the mug.

This finding reveals a somewhat counterintuitive benefit of cash: by making purchases more painful, it can make the things we buy more appreciated. When people say “I appreciate it more because I paid in hard-earned cash,” there is psychological truth to that. It ties into the concept of the *endowment effect* (people value something they own more than its market value) but here the endowment is enhanced by the method of payment. Cash payers essentially endow their purchases with greater value to match the felt cost. While one might think feeling pain in purchasing is purely negative, it appears to encourage a mindful, deliberate consumer who truly weighs the trade-off and, if they proceed, tends to cherish the outcome more. In a world of frictionless one-click orders that are quickly forgotten, a cash purchase can be a more meaningful transaction, both in consideration and in subsequent satisfaction.

5.3. The Role of Tangibility in Budgeting and Self-Control

Because cash is tangible, it naturally lends itself to concrete budgeting methods. Many people practice the envelope budgeting system – allocating physical cash into envelopes for rent, groceries, entertainment, etc. This system has endured through generations because it imposes discipline: you can literally see and *feel* when an envelope is getting empty, which serves as a clear signal to cut back. There is evidence that such tactile budgeting improves self-control. In a study on impulsive spending, participants who used a labeled envelope for discretionary cash managed their spending significantly better over several weeks than those who kept the equivalent funds in a bank account accessible by debit card (Heilman, 2019). The envelope users reported that they thought twice before breaking a bill or using up the last of an envelope, whereas the card users had a harder time tracking their limit. Even when both groups technically had the same spending limit, the physical partitioning of cash acted as a strong commitment device.

Cash also prevents overspending by default – if you bring only \$40 in cash for a night out, you can’t spend more than \$40. That physical cap is a straightforward yet powerful form of self-regulation. Behavioral economists have noted that using cash can help circumvent one’s own willpower failures by externally limiting options (Thaler & Shefrin, 1981). This is similar to the idea of a diet: if you don’t keep junk food in the house, you won’t eat it in a weak moment. Similarly, if you don’t carry cards or digital access, you can’t impulsively tap

into extra funds. Surveys of consumers have found that a portion deliberately adopt “cash-only” rules when they need to save money – e.g., when on a tight budget or trying to recover from holiday spending – and a common reason cited is “with cash I notice every dollar; it keeps me accountable” (Visa Canada, 2017 survey, as summarized in Cash Matters, 2021).

From a self-control perspective, cash heightens the *psychological friction* at the point of purchase and thus can serve as a speed bump for our impulsive tendencies. The ease of digital payments, conversely, has been implicated in problems of compulsive buying and gambling.

On the flip side, there is evidence that when people rely heavily on cashless modes, they may develop poorer financial habits if not careful. A study by Šujecký and Urbanová (2019) in the Czech Republic found that young adults who used predominantly cards and contactless payments were more likely to report running out of money by month’s end and having trouble sticking to budgets, compared to those who intentionally used cash for day-to-day expenses. The authors attributed this partly to lower salience of expenses – digital spenders weren’t fully registering each small purchase, whereas cash spenders noticed their wallet thinning and adjusted behavior. As one participant vividly put it, “When I use my card it feels like play money – I spend and I’m like, oh well. When I use cash, I physically see my limit and it freaks me out in a good way” (Šujecký & Urbanová, 2019). This anecdote encapsulates how cash can instill a healthy sense of financial caution.

To be clear, using cash does not magically make one financially responsible – one can still overspend in cash if they try (e.g., by borrowing cash or emptying savings). However, the threshold to do so is higher, and the psychological cues are more immediate. It’s those *in-the-moment cues* and *sensory feedback* that shape daily behavior.

Furthermore, using cash might promote a more categorical thinking about money that aids budgeting. Research on mental accounting (Thaler, 1999) shows that people often divide money into categories (rent, food, entertainment), and while sometimes such mental accounts are arbitrary, they can help prevent raiding funds intended for one purpose to cover another. With digital money, it’s all in one account (unless actively divided), so a dinner out just reduces the same balance that pays your rent – mentally, the boundaries blur. With cash, people often literally set aside certain bills for specific purposes (e.g., \$100 kept at home is “off-limits” emergency fund, or \$20 in one’s wallet is “for taxi fare only”). That physical segregation reinforces mental budgeting. Even the physical size of a stack of

cash can act as a heuristic: seeing only a thin stack left in your wallet triggers caution, whereas a bank balance number might not evoke the same gut feeling until it's dangerously low.

5.4. Why Tangibility Matters: Parallels from Handwriting and Embodied Cognition

The psychological effects of cash's tangibility can be better understood by drawing parallels to other domains where analog vs. digital formats impact cognition. A notable example is note-taking by hand versus on a laptop. Mueller and Oppenheimer (2014) famously found that students who took notes longhand on paper had better conceptual understanding and memory of lecture material than those who took notes on a computer. Writing by hand is slower and involves more mental processing (you can't write everything verbatim, so you must summarize in your own words), and the kinesthetic activity of forming letters engages the brain more deeply. Typing, while faster and capturing more raw content, tends to be more mindless transcription with shallower processing. The analogy to money is that physical transactions (like writing longhand) require more engagement – you must physically count cash, ensure you have enough, receive change, etc., all of which makes you mentally process the transaction. Digital transactions (like typing notes) can be done with far less cognitive effort – just tap or swipe, and an automated system handles the rest – which may result in less encoding of the fact that you spent money or what it meant.

Similarly, reading on paper vs. on screen has shown differences: some studies indicate that people may comprehend or recall text slightly better from paper, possibly because the physical layout and sensation provide more context cues (Mangen, Walgermo, & Brønnick, 2013). In the realm of money, physical money provides multisensory cues – the texture of notes, the clinking of coins, the diminishing weight of one's wallet – which collectively act as cues and memory anchors for spending. Digital money is visually represented (digits on a screen) but lacks the multi-sensory richness, potentially making the experience less memorable. A cash transaction might stick in your mind (“I handed the cashier two twenties and got a five back”) whereas an electronic transaction might leave no trace in memory unless you actively check a statement.

Neuroscience research on handwriting by Van der Meer and Van der Weel (2024) showed that writing by hand led to “widespread brain connectivity” patterns involving memory and sensorimotor integration, which were not present when typing. They argue that the precise hand movements and feedback from pen and paper activate brain networks that promote learning and retention (van der Weel & van der Meer, 2024). By extension, handling cash

might activate broader neural circuits (touch, vision, calculation) compared to a largely abstract digital transaction that might only briefly engage visual recognition of numbers. That broader activation could mean a spending event is encoded more richly in memory and awareness.

This concept falls under embodied cognition – the idea that our cognition is deeply influenced by our bodily interactions and sensory experiences. Money that you can physically manipulate becomes *embodied* in a way digital money does not. Young children, for example, often learn to count and understand quantity using physical objects (blocks, fingers, coins) because concrete objects ground abstract concepts in reality. If children engage with physical money, they can tangibly grasp the idea of “I exchanged something valuable for an item” or “I saved these many coins and now I have enough for a toy.” If their “money” is just numbers in a parental app that get deducted invisibly, the learning opportunity is diminished.

We see evidence of this in parental reports: many parents say that when allowances are given on a card or app, kids have trouble connecting that to real purchasing power, whereas when given in cash, they quickly learn that if they spend it all, they have nothing left until next allowance (Kids Financial Literacy Study, 2019). One might equate this to the difference between teaching math with physical manipulatives versus purely symbolic equations. The tangible approach builds foundational intuition.

Overall, tangibility matters because it engages more of our human cognitive apparatus. We evolved to deal with physical resources – our ancestors traded objects, counted livestock, stored food. Abstract money is a relatively new invention, and abstract digital money even newer, which may not instinctively trigger the same prudent behavior that handing over a physical asset does. By harnessing embodied cognition, cash aligns our minds with our finances in a very direct way: you *feel* the loss of resources when you pay with cash, and you *feel* the presence of resources when you hold cash, thus you manage those resources with a keen sense of ownership and scarcity. As Khan and Belk (2024) eloquently noted, “When we handle cash, we are not just spending money; we are parting with a piece of ourselves.” That quote encapsulates the intimate psychological connection fostered by tangible currency.

Having explored the cognitive-behavioral advantages of cash – from spending restraint and budgeting to emotional and learning benefits – we will now shift focus to developmental aspects and the impacts on children and young people. Understanding money is a critical

life skill, and the form in which children first encounter money can shape their comprehension. We'll examine research on how using cash vs. digital money influences children's financial development and what implications this has in an increasingly cashless society.

6. Developmental and Educational Implications: Cash as a Learning Tool

Children's early experiences with money set the foundation for their future financial behaviors and attitudes. In generations past, these experiences typically involved tangible money: receiving coins from relatives, filling a piggy bank, or buying candy with saved allowance. Today's children, however, are increasingly likely to see their parents tap a card or phone to pay, or receive their allowance via a banking app or prepaid debit card. This raises an important question: Does the physicality of cash aid children in learning about money? Many experts and studies suggest that it does. Physical money provides concrete lessons in counting, exchange, and the finite nature of resources that can be harder for kids to grasp with invisible digital transactions. In this section, we explore how using cash (or lack thereof) affects children's cognitive development around money – including their understanding of value, self-control, and financial responsibility – and discuss the potential consequences of growing up in a largely cashless environment.

6.1. Early Understanding of Money: The Role of the Concrete

Research in developmental psychology indicates that children begin to develop rudimentary understanding of money and exchange by around ages 3–4, though their concepts are very basic at that stage (Abramovitch et al., 1986). They might understand that coins and bills can be traded for goodies, but not necessarily why money has value or that different coins have different denominations. By around age 7–8, most children can comprehend that money is a limited resource and begin to grasp the idea of saving (Webley & Lea, 1993). Crucially, these early understandings are greatly helped by tangible interactions. A child who physically trades 2 quarters for a small toy learns through that concrete action about equivalence and exchange: they gave up something they owned (coins) to get something else they wanted. If the child only ever sees a parent pay on a phone, the concept of what was given up is abstract – they may see the toy being acquired but not the sacrifice.

A famous report by researchers at the University of Cambridge (Whitebread & Bingham, 2013), commissioned by the UK's Money Advice Service, concluded that *many core financial habits are formed by age 7*. By that age, most children have grasped the idea of value (that some things cost more than others), are capable of complex play that involves buying and selling (like playing store), and can practice delaying gratification with money (e.g., saving up for something). However, the report emphasizes that hands-on experience is key: children learn by doing. The authors advised parents to give children real money to manage in small ways (like a weekly allowance in cash) to build skills like budgeting and making choices. They warn that if everything is done out of sight (e.g., a parent's card covers all expenses), children may not internalize those lessons (Whitebread & Bingham, 2013).

One concrete example is numeracy and counting. Handling cash helps children practice addition and subtraction in a real-life context. For instance, a child might have five \$1 bills and realize that after buying a \$2 item, they have three left; this visible countable process reinforces arithmetic. When those transactions are electronic, the child may not be involved in the calculation at all – an app just shows a new number, if they even look at it. Some educational programs encourage parents to let children physically count out the money for a purchase and hand it to the cashier, even if the parent immediately pays them back or could have used a card, because this ritual teaches important skills and concepts (Danby, 2017). It also introduces emotional skills: the child might feel a pinch giving away their money and thus start learning the trade-off concept (“If I buy this, I won’t have those dollars anymore”).

6.2. The Disconnection Caused by Cashless Transactions for Youth

There is growing evidence that children and teens find digital money more difficult to conceptualize. A large survey in the UK in 2019 (Youth Financial Capability Survey) found that 72% of parents believed their children “don’t fully understand the value of money” in the context of digital spending, and a majority of teachers (78%) felt that the move towards cashless transactions was “*damaging children’s ability to learn about money*” (Prudential, 2014, as cited in Mondato Insight, 2020). One reason is that when children don’t physically handle money, they may think of purchases as just getting things by magic. Parents reported kids saying things like “why can’t you just use the card if you don’t have money?” – not realizing that the card draws from a limited account (Mondato Insight, 2020). In one telling anecdote, a child who saw his parent take cash out of an ATM commented that the machine just gives money whenever one wants; without seeing the link to a bank account that needed funds, the child assumed money is an abundant resource you request from

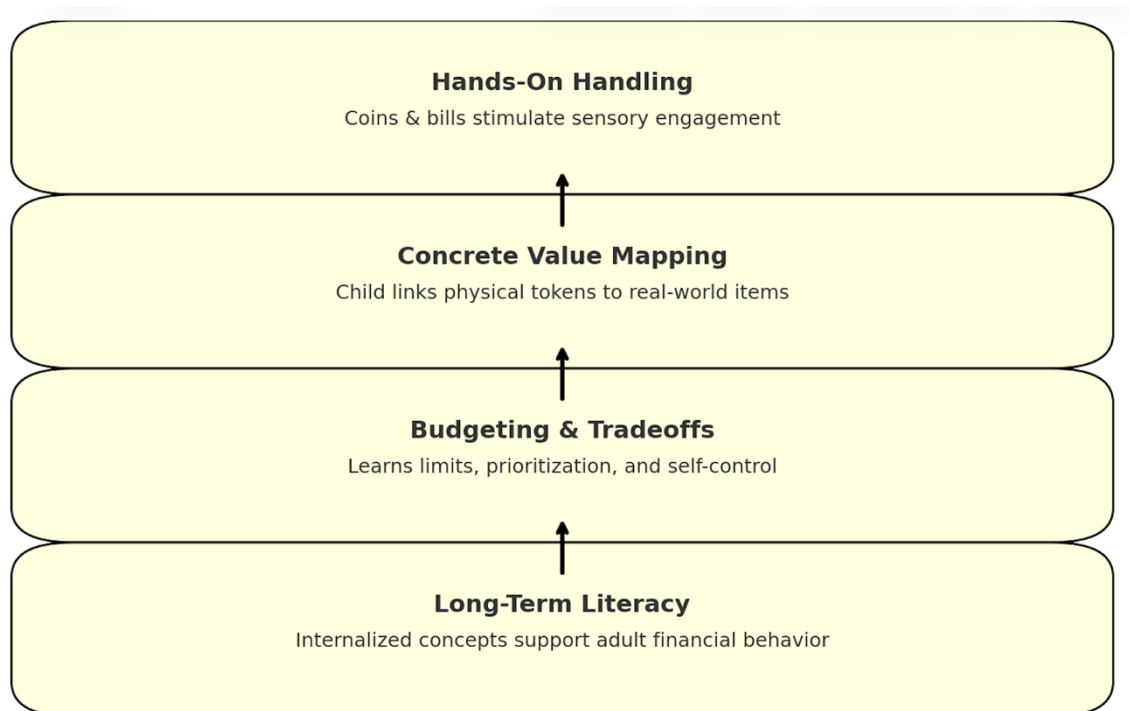
machines (Akhtar, 2019). This highlights a misconception that can arise without tangible cues.

Digital forms also often mask the *source* of money. When a parent hands a child \$5, the child knows the parent had to give that \$5 from their wallet (a finite resource). If a parent instead transfers \$5 in an app, children might perceive it as just numbers appearing, not fully appreciating that it still came from the parent's finite funds. The lack of a visible giver and receiver can dilute the understanding of money's interpersonal and scarcity aspects.

Impulse control in spending is another developmental concern. Children and teens are naturally impulsive to varying degrees; learning to control spending is part of maturing. If a child has physical cash, once it's gone, it's gone – a clear feedback loop that they spent it. With digital forms, there's a danger of seamless spending (especially if connected to a parent's account or if the child has a stored-value card that auto-reloads). We've seen high-profile cases of children racking up hundreds of dollars in in-app purchases on games without fully realizing it was "real money" – precisely because it didn't feel real to them (Narasimhan, 2018). While these are extreme examples, they underscore that without the tactile stopgap of cash (you physically run out), a child could click "buy" repeatedly, chasing the immediate gratification, and only later face the consequences (or more likely, the parent does). For teenagers, who often start earning and spending more on their own, digital money can either be a boon or a bane. On one hand, budgeting apps and online banking could help a responsible teen track their money; on the other hand, peer pressures and the one-click ease of e-commerce might lead to overspending if they haven't internalized good habits.

A summary on the importance of tangibility on children's financial development is shown in Figure 2.

Figure 2: Tangibility and Financial Development in Children



6.3. Cashless Society and Financial Education

As economies trend toward cashlessness, educators and policymakers are recognizing the need to adapt financial education for a digital age. But many emphasize not abandoning the *pedagogy of physical money* in early education. The Bank of England (2018) published an article discussing financial education in a digital world, and one point made was that while digital literacy is important, young children benefit from starting with analog concepts to build a foundation. They recommended using coins and play money to teach concepts in primary school, then gradually introducing digital money concepts (like reading a bank statement or using a budgeting app) in later years once the fundamental notion of money's value is established (BoE, 2018). In essence, crawl before you walk: let kids understand money's meaning with concrete examples, then teach them how the same principles apply to cards and electronic transfers.

There are also interesting programs like "Life Skills" classes where schools set up token economies or school currencies to simulate a cash economy for students, precisely to give

them practice in earning, saving, and spending decisions. In a largely cashless future, such simulated environments might become even more necessary to impart practical money management experience that previous generations picked up by handling their pocket money.

One novel angle is comparing the learning of digital money to the learning of digital vs. analog time-telling. As children still learn to read analog clocks to grasp the concept of hours and minutes (even though digital clocks are everywhere), children should learn to use cash to grasp the concept of financial value. The analog clock physically represents the cyclical nature of time, which can aid understanding before moving to reading numeric displays. Analog cash (coins/bills) physically represents economic exchanges, which can aid understanding before moving to swiping a card.

In support of maintaining cash usage for learning, one could also argue from a social equity perspective: not all learning is purely intellectual, some is experiential and social. When a child takes cash to a corner store and interacts with a shopkeeper to buy something, they learn not only about money but also communication, waiting for change, saying thank you – a social transaction. In a fully automated digital purchase, some of that social learning is bypassed. Anthropologists studying money have often pointed out that money has social and cultural dimensions, not just economic ones (Zelizer, 1994). Cash given as a gift (like a grandparent handing a \$10 note on a birthday) conveys a personal touch and a lesson in generosity and value that maybe a bank transfer doesn't quite replicate in the child's mind.

Of course, digital money isn't going away – so efforts are being made to incorporate it into teaching in kid-friendly ways. For example, some allowance apps now provide visuals like virtual jars or piggy banks on screen, where kids can drag their digital coins into “savings” or “spending” jars to mimic the act of portioning physical money (Johnson, 2020). These apps attempt to create a bridge between the tangible and intangible by visual metaphor. Many parents reportedly adopt a hybrid approach – giving younger kids physical money and then as they reach middle school, transitioning them to a teen debit card, but only after they've had several years of practice managing cash (Anderson & Jiang, 2018).

All in all, the broader theme emerging from all our discussions is that *tangibility and friction have cognitive benefits*. Whether it's an adult curbing their spending or a child learning what money is, the physical aspects of cash impose a discipline and clarity that is hard to replicate in an all-digital world. In the final section, we will synthesize these insights and consider their implications on a societal and policy level. What does it mean for personal

finance, consumer protection, and financial inclusion if cash disappears? Are there ways to integrate the best of both worlds (digital convenience with some of cash's benefits)? We will also highlight how interdisciplinary research – spanning economics, psychology, neuroscience, and education – can guide balanced decision-making as we navigate the future of payments.

7. Global and Policy Implications: Balancing Digital Progress with Cognitive Well-being

The evidence reviewed in this paper makes a compelling case that cash offers unique cognitive and behavioral advantages: it promotes prudent spending, enhances psychological ownership, aids learning about money, and engages neural mechanisms of self-regulation. These benefits, however, must be weighed against the undeniable conveniences and innovations of digital finance. As societies worldwide advance toward greater financial digitization – a trend often driven by efficiency, cost reduction, and technological enthusiasm – there is a risk of inadvertently discarding the “speed bumps” and educational scaffolding that cash provides. This final section discusses the broader implications of a declining cash landscape and offers considerations for policy and financial system design. How can we preserve the lesser-known benefits of cash in an increasingly cashless world? And why might it be important for policymakers, banks, and educators to pay attention to these psychological factors?

7.1. Cash Use and Consumer Well-being Across Countries

Cash remains a significant part of the payment ecosystem in many countries, albeit to varying degrees. For instance, as of the mid-2020s, countries like Germany and Japan still carry out a large proportion of consumer transactions in cash, partly due to cultural preferences and trust in physical currency. In contrast, Sweden or South Korea have rapidly moved toward cashlessness, with very high adoption of electronic payments even for small amounts. Interestingly, cultural attitudes reflect some awareness of the issues discussed.

A global challenge is ensuring financial inclusion and resilience. Cash is universally accessible – it doesn't require a smartphone, internet, or even electricity. From a policy

standpoint, completely eliminating cash could marginalize certain groups (the elderly, low-income without banking access, or those with cognitive impairments who find digital interfaces difficult). While this relates more to practical inclusion than cognitive benefits per se, it intersects with our discussion: those very groups often rely on cash as a tool to manage their finances in straightforward ways. For example, some older adults deliberately withdraw a weekly sum to budget because it's a method they trust and understand, aligning with the cognitive strengths of cash (Stix, 2013). Removing that option might expose them to greater risk of financial errors or exploitation via unfamiliar technologies.

At a societal level, one could argue there is a mental health and financial health aspect to retaining some cash usage. Studies have correlated heavy credit card debt with stress and decreased mental well-being (Sweet et al., 2013). While debt has many causes, the overspending facilitated by low-friction payments is a contributing factor. By maintaining an environment where cash is readily usable, individuals have the means to opt for a mode of payment that naturally moderates spending. Anecdotally, debt counselors sometimes advise clients to move to an all-cash budget temporarily to regain control (as noted earlier). Societies that move away from cash will need to find other ways to help individuals impose spending discipline – possibly through fintech solutions that simulate cash's feedback (e.g., real-time spending notifications that “speak” to the user or visual trackers of budget depletion).

There is also the argument of choice. As the Cash Matters initiative (an advocacy group) often states, maintaining cash alongside digital options lets people choose the method that best fits their needs and self-regulation style. A one-size-fits-all approach might ignore the diversity in how people psychologically interact with money. Some individuals might do fine with fully digital finances (perhaps those naturally high in conscientiousness or those who harness personal finance apps effectively), whereas others benefit from the tactile and visual cues of cash. Public policy that safeguards the availability of cash (for example, ensuring ATMs and bank branches remain in rural areas, or mandating businesses to accept cash to a reasonable degree) can be seen as supporting not just inclusion but also the cognitive diversity of consumers. In the U.S., for instance, several cities and states have passed laws requiring retail stores to accept cash, citing that refusing cash discriminates against those who either lack digital access or simply manage better with cash (Wong, 2020). Implicit in that is an understanding that cash is a basic tool that citizens should be able to use freely, much like a public utility.

7.2. Integrating Cash's Benefits into Digital Design

If we acknowledge that cash has beneficial effects, the next question is: can we incorporate those effects into digital payment systems? Financial technology designers are increasingly aware of behavioral economics and are experimenting with features to enhance user awareness and control. For example, many banking apps now have automatic expense categorization and visual budget bars that turn red as one approaches the limit. Some apps allow users to set spending alerts – effectively creating an “ouch” signal when they spend over X amount in a day, akin to the insula’s warning if one were paying in cash. There are also “round-up” savings programs that try to tap into psychological tricks: e.g., every time you spend, it rounds up and puts the remainder in savings, subtly making spending feel a bit more costly to encourage thriftiness.

Another area is credit card interface redesign. Traditional credit cards made it quite easy to ignore one’s spending until the monthly statement. Now, most banking apps show your credit card transactions in real-time; some send push notifications for each use, effectively saying “you just spent \$30 at Restaurant X.” This immediate feedback goes some way to mimicking the immediate awareness that comes with a cash payment (where you literally count out \$30 and feel its absence). Here we see an example of using digital technology to *compensate for* one of its own pitfalls – by deliberately injecting awareness that wasn’t inherently there.

Policy could encourage or require these kinds of features – for instance, regulators could push for transparency defaults like mandatory spending notifications or easy access to spending summaries, as part of consumer protection in digital banking. Just as nutrition labels are required on foods to inform consumers, one could envision “financial health” nudges required in fintech interfaces to keep consumers informed and in control.

Educational interventions are also critical. If cash becomes less present in everyday transactions, schools might need to update curricula to teach financial concepts in more depth since children won’t absorb them implicitly by using cash. Some countries have already expanded financial literacy programs; for example, Australia and Canada have integrated personal finance topics, including the differences between payment methods, into their K-12 education standards (OECD, 2020). Ensuring that young people understand how credit works, the psychological tricks of marketing, and the need to self-regulate in a cashless world is increasingly important. In lieu of learning by doing with cash, they must learn by *simulating* or *analyzing* digital money flows.

One novel strategy in education is the use of gamified financial simulations. For instance, some schools use online budgeting games where students get a virtual salary and must navigate expenses for a month, sometimes deliberately exposing them to the consequences of using a credit card too freely versus using a debit system. These simulations can impart the “pain” by showing them virtually running out of money or accruing interest on debt – basically, creating a safe environment to experience why overspending hurts. While not as direct as real cash, these exercises leverage the power of experience and reflection, hopefully instilling more cautious habits.

7.3. Preserving Cash’s Role

Despite the push towards digital, there is likely to be a continued role for cash for the foreseeable future, even if diminished. Governments and central banks in many regions have committed to ensuring cash remains available and accepted as legal tender. Part of the reason is resilience (cash works when electronic systems fail or in disasters), but part is also public demand and trust. Surveys often show that people derive a sense of security from having some cash on hand “just in case” (European Central Bank, 2022). That psychological security is a benefit in itself – people feel more in control when they have a tangible store of value at their disposal. During uncertain times (economic crises, pandemics), demand for cash often spikes as individuals revert to what they perceive as a stable and universally accepted form of money (perhaps also because in crises, controlling one’s budget becomes paramount and cash helps with that).

In policy discussions, one interesting angle is whether future innovations like Central Bank Digital Currencies (CBDCs) could incorporate features that mimic cash. A CBDC, being a digital version of cash, could be designed with certain privacy features or offline capability to resemble cash usage. But could it also be designed to promote healthy spending behavior? For example, a CBDC app might allow people to visually segregate funds, or even have an opt-in setting that limits transaction frequency or volume (like a self-imposed governor). While central banks likely won’t go so far as to paternalistically restrict spending, providing tools akin to cash’s self-regulation might be considered a value-add. At minimum, preserving some anonymity in small CBDC transactions could maintain the feeling of freedom that cash gives (which is beyond our cognitive scope here but still a psychological comfort).

Finally, it's worth highlighting that the goal is not to idolize cash as perfect or demonize digital payments – rather, it's to achieve an optimal balance. The world has much to gain from digital finance: speed, cost efficiency, easier record-keeping, inclusion through mobile banking, etc. But as with any technology, there are unintended side effects – in this case, the loss of friction and tangible feedback. Recognizing those side effects allows us to mitigate them. The ideal future might be one where digital systems are deliberately crafted to be *humane and user-centric*, incorporating behavioral insights so that individuals can enjoy convenience without jeopardizing their financial well-being.

In conclusion, the “lesser-known” benefits of cash we have explored are not merely nostalgic attachments to an old form of money; they represent fundamental human factors in how we deal with resources and make decisions. The tangibility, transparency, and simplicity of cash engage our brains and behaviors in constructive ways that shouldn't be lightly dismissed. As we progress into a more cash-lite society, the challenge and responsibility will be to retain those constructive elements—whether by keeping cash in circulation for those who need it, or by encoding its lessons into the design of new financial tools. By doing so, we can ensure that innovation in payments continues to serve human interests, not just technological or commercial ones.

8. Conclusion

Money is much more than numbers on a ledger; it is woven into our cognitive processes, emotions, and social practices. This comprehensive review has highlighted that the form of money – whether physical cash or digital bytes – can significantly shape our financial behaviors and experiences. While cash is often overshadowed by the narrative of progress favoring digital payments, the evidence across disciplines reveals that cash carries a suite of *underappreciated benefits* crucial to personal and societal financial health.

We saw how paying with cash introduces friction and psychological “pain” that, far from being detrimental, serves as a useful check on overspending. The tactile act of handing over money activates neural and emotional circuits (e.g., insula-mediated aversion) that help us register the reality of spending, thereby promoting self-control. Cash makes costs salient – each bill parted with is a clear loss felt – and this naturally encourages consumers to think twice about purchases. In contrast, frictionless payments anesthetize that feedback, often leading to higher spending and potential debt. Cash's tangibility also enhances our sense of ownership and value: people perceive and treat money more carefully when it is in palpable

form. This extends to greater post-purchase satisfaction and responsibility; one is more likely to cherish an item bought with hard cash than one acquired with a wave of a card, because the former involved a conscious sacrifice.

For children and young adults, physical money has proven pedagogical value. It provides an intuitive, hands-on medium for learning about numbers, trade-offs, and budgeting. The lessons a child learns by saving coins in a jar or spending a few dollars at a store are lessons of concretely understanding value, scarcity, and decision-making. Digital transactions, while second-nature to digitally native youth in mechanics, do not inherently impart those lessons – in fact, they risk leaving a conceptual void where money “doesn’t feel real.” Our review underscored that many parents and educators observe young people struggling with abstract money, reinforcing the importance of experiential learning with physical currency or thoughtfully designed analogies for it. As financial education adapts to the digital age, incorporating the core principles that cash once organically taught – such as immediacy of loss and finite resources – will be paramount.

Cutting-edge neuroeconomic studies corroborate what behavioral research long hinted: the medium of payment alters the brain’s decision calculus. Cash lights up the brain’s alarm bells (insula) and engages deliberative areas, essentially signaling “caution – value leaving hand,” whereas credit cards and mobile payments entice the brain’s reward networks (striatal dopamine release) with an easy high of acquisition. This neural evidence adds weight to the argument that cash can act as a natural self-regulation tool. It also serves as a warning that if we remove all friction, we may need other mechanisms to prevent the brain from tilting too far to the reward side without checks. In effect, the move toward a cashless society is a grand natural experiment on our collective financial behaviors; understanding these brain-behavior links helps policymakers and individuals prepare and adjust.

Different countries might strike different balances between cash and digital, but a recurring theme is the need to preserve choice and cognitive diversity. Not everyone navigates the financial world in the same way; some thrive on digital efficiency, others rely on cash’s clarity. Policymakers would do well to ensure that cash infrastructure (ATMs, acceptance rules) does not disappear prematurely, especially for vulnerable segments of the population. At the same time, encouraging innovation that makes digital payments more “cash-like” in beneficial ways – for example, apps that display visual spending limits or issue timely alerts – could marry the best of both worlds. Financial institutions and fintech developers are increasingly aware of behavioral science, but industry standards could be developed (in consultation with psychologists and consumer advocates) to integrate

features that promote financial wellness. This might include things like default spending reports, easy-to-use budgeting tools, or settings that allow users to impose gentle frictions (a cooling-off period for large online purchases, for instance).

It is somewhat ironic that as we push into ever more advanced financial technology, we are rediscovering the wisdom embedded in an ancient technology – cash. The challenge ahead is not to resist change, but to humanize it. Cash as a physical object cannot be wholly replicated in digital form, but the *effects* it has on us can be appreciated and consciously woven into the fabric of new monetary systems. This could involve public education campaigns about mindful spending, incorporating financial literacy in school curricula from early ages, and perhaps reframing how we culturally think about money. For instance, developing social norms around prudent use of contactless payments (the same way earlier generations taught norms around credit card use – “don’t buy on credit what you can’t afford in cash”) could instill a slight psychological pause even when using high-speed payment methods.

The findings we’ve discussed emerge from a convergence of fields – behavioral economics, consumer psychology, neuroscience, education, and more. This underscores that the topic of money is inherently interdisciplinary; each field sheds light on a different facet of why cash works the way it does on human behavior. Going forward, continued research at these intersections will be valuable. For example, longitudinal studies on cohorts that grow up in nearly cashless households versus those with cash exposure could reveal long-term differences in financial outcomes. Neuroimaging studies on new forms of payment (such as wearables or even implanted chips) could tell us whether further removal of tangibility exacerbates or mitigates the effects observed with cards. Policymakers might collaborate with scientists to pilot and measure interventions (like specific app features or educational modules) that aim to substitute for cash’s benefits.

Cash has been a trusted companion of humanity for millennia, not just because it facilitates trade, but because it is intuitively understood. The clink of a coin, the crispness of a banknote, the lightness of an emptied wallet – these are sensations and signals that resonate with our human psyche. As we step into a future dominated by invisible bytes and seamless transactions, we should carry forward the lessons that cash taught us about self-restraint, value, and reality. In a sense, the wisest financial systems will be those that acknowledge human nature – with all its biases and limitations – and build in structures that guide us toward outcomes that improve our well-being. Cash did that organically; now it’s up to us to do it deliberately.

References

- Abramovitch, R., Freedman, J. L., & Pliner, P. (1986). Children and money: Getting an allowance, credit versus cash. *Journal of Economic Psychology*, 7(3), 271-282.
- Akhtar, A. (2019). Kids don't understand how digital purchases work – here's why that matters. *The Guardian*. (Oct 2019).
- Anderson, M., & Jiang, J. (2018). Teens, Social Media & Technology. *Pew Research Center*. (May 2018).
- Banker, S., Dunfield, D., Huang, A., & Prelec, D. (2021). Neural mechanisms of credit card spending. *Scientific Reports*, 11(1), 4070.
- BoE (Bank of England). (2018). Financial education in a digital world: Agenda for research. *Quarterly Bulletin*, 2018 Q2.
- Ceravolo, M. G., Fabri, M., Fattobene, L., Polonara, G., & Raggetti, G. (2019). Cash, card or smartphone: The neural correlates of payment methods. *Frontiers in Neuroscience*, 13, 1188.
- Danby, S. (2017). How parents can teach kids the value of money in a cashless society. *The Conversation*. (Nov 2017).
- Demirgüç-Kunt, A., Klapper, L., Singer, D., & Ansar, S. (2022). The Global Findex Database 2021: Financial Inclusion, Digital Payments, and Resilience in the Age of COVID-19. Washington, DC: World Bank.
- European Central Bank. (2022). *Study on the payment attitudes of consumers in the euro area (SPACE)*.
- Feinberg, R. A. (1986). Credit cards as spending facilitating stimuli: A conditioning interpretation. *Journal of Consumer Research*, 13(3), 348-356.
- Hirschman, E. C. (1979). Differences in consumer purchase behavior by credit card payment system. *Journal of Consumer Research*, 6(1), 58-66.
- Johnson, T. (2020). Digital piggy banks: The rise of allowance apps. *Wall Street Journal*. (Aug 2020).

Kamleitner, B., & Erki, B. (2013). Payment method and perceptions of ownership. *Marketing Letters*, 24(1), 57–69.

Khan, J., & Belk, R. (2024). Money you could touch: Cash and psychological ownership. *Qualitative Market Research: An International Journal*, 27(5), 820-840.

Knutson, B., Rick, S., Wimmer, G. E., Prelec, D., & Loewenstein, G. (2007). Neural predictors of purchases. *Neuron*, 53(1), 147-156.

Liu, X., & Dewitte, S. (2021). Money or happiness: When lower pain of paying fails to boost purchase satisfaction. *International Journal of Research in Marketing*, 38(4), 1014-1031.

Ma, Q., Tan, Y., He, Y., & Wang, M. (2024). Why does mobile payment promote purchases? Revisiting the pain of paying, and understanding the implicit pleasure via selective attention. *PsyCh Journal*, 13(3), 381-394.

Mangen, A., Walgermo, B. R., & Brønnick, K. (2013). Reading linear texts on paper versus computer screen: Effects on reading comprehension. *International Journal of Educational Research*, 58, 61-68.

Mondato Insight. (2020). Kids and digital money: Abstracting value for the next generation. *Mondato Blog*. (July 2020).

Mueller, P. A., & Oppenheimer, D. M. (2014). The pen is mightier than the keyboard: Advantages of longhand over laptop note taking. *Psychological Science*, 25(6), 1159-1168.

OECD. (2020). *OECD PISA Financial Literacy Assessment – findings and country highlights*.

Prelec, D., & Loewenstein, G. (1998). The red and the black: Mental accounting of savings and debt. *Marketing Science*, 17(1), 4-28.

Prelec, D., & Simester, D. (2001). Always leave home without it: A further investigation of the credit-card effect on willingness to pay. *Marketing Letters*, 12(1), 5-12.

Prudential. (2014). *Parents, Kids & Money Survey*. Prudential PLC.

Raghubir, P., & Srivastava, J. (2008). Monopoly money: The effect of payment coupling and form on spending behavior. *Journal of Experimental Psychology: Applied*, 14(3), 213-225.

Raghubir, P., & Srivastava, J. (2009). The denomination effect. *Journal of Consumer Research*, 36(4), 701-713.

Revolut. (2021). *Revolut User Insights: Vault Savings Feature*. Internal report (summary published on Revolut blog).

Reshadi, F., & Fitzgerald, M. P. (2023). The pain of payment: A review and research agenda. *Journal of Consumer Psychology*, 33(1), 148-167.

Rick, S., Cryder, C. E., & Loewenstein, G. (2008). Tightwads and spendthrifts. *Journal of Consumer Research*, 34(6), 767-782.

Runnemark, E., Hedman, J., & Xiao, X. (2015). Do consumers pay more using debit cards than cash? *Electronic Commerce Research and Applications*, 14(5), 285–291.

Shah, A. M., Eisenkraft, N., Bettman, J. R., & Chartrand, T. L. (2016). “Paper or plastic?” How we pay influences post-transaction connection. *Journal of Consumer Research*, 42(5), 688–708.

Smith, A., et al. (2021). An educational intervention using a digital piggy bank app: Effects on children’s financial literacy. *Children and Youth Services Review*, 121, 105881.

Soman, D. (2001). Effects of payment mechanism on spending behavior: The role of rehearsal and immediacy. *Journal of Consumer Research*, 27(4), 460-474.

Stix, H. (2013). Why do people save in cash? Distrust, memories of banking crises, weak institutions and dollarization. *Journal of Banking & Finance*, 37(11), 4087-4106.

Sweet, E., Nandi, A., Adam, E. K., & McDade, T. (2013). The high price of debt: Household financial debt and its impact on mental and physical health. *Social Science & Medicine*, 91, 94-100.

Šujecký, M., & Urbanová, M. (2019). Cash or card? Payment form preferences and financial behavior of young consumers. *Journal of Consumer Policy*, 42, 531-555.

Sveriges Riksbank. (2020). *Payments in Sweden 2020* – annual report.

Thaler, R. H. (1999). Mental accounting matters. *Journal of Behavioral Decision Making*, 12(3), 183-206.

Thaler, R. H., & Shefrin, H. M. (1981). An economic theory of self-control. *Journal of Political Economy*, 89(2), 392–406.

Thomas, M., Desai, K. K., & Seenivasan, S. (2011). How credit card payments increase unhealthy food purchases: Visceral regulation of vices. *Journal of Consumer Research*, 38(1), 126–139.

Tokunaga, H. (1993). The use and abuse of consumer credit: Application of psychological theory and research. *Journal of Economic Psychology*, 14(2), 285-316.

Van der Weel, F. R., & van der Meer, A. L. H. (2024). Handwriting but not typewriting leads to widespread brain connectivity: A high-density EEG study. *Frontiers in Psychology*, 14, 1219945.

Visa Canada. (2017). *Canadians' attitudes towards cash vs. digital payments*. Pollara Survey for Visa.

Webley, P., & Lea, S. E. (1993). The partial unacceptability of money in repayment for favors. *Journal of Economic Psychology*, 14(1), 53-72.

Whitebread, D., & Bingham, S. (2013). *Habit Formation and Learning in Young Children*. Report for Money Advice Service, University of Cambridge.

Wong, J. (2020). US cities and states are banning cashless stores, citing discrimination. *CNN Business*. (Jan 2020).

Zelizer, V. (1994). *The Social Meaning of Money*. Basic Books, New York.

Zellermayer, O. (1996). The pain of paying. Doctoral dissertation, Department of Social and Decision Sciences, Carnegie Mellon University.

Zhou, K., Ye, J., & Liu, X. (2023). Is cash perceived as more valuable than digital money? The mediating effect of psychological ownership and psychological distance. *Marketing Letters*, 34(1), 55-68.