The Currency of Mood: The Use of Open Banking APIs to Better Understand Spending and Bipolar Disorder

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Bipolar disorder (BD) is associated with risky financial behaviors, and individuals living with BD experience a 50% greater likelihood of bankruptcy than the general population. This methods paper documents our pilot study collecting financial data from individuals with BD. We developed a prototype to collect transaction data via open banking APIs alongside retrospective mood reporting. Our methodology prioritized establishing participant trust and preserving privacy by limiting collected financial data types, implementing remote participant control of a secured prototype, and incorporating researcher disclosure of lived experience with BD. Participants demonstrated strong acceptance, with several reporting that financial issues were significant enough that they would share more data types. Key technical challenges emerged as many financial institutions do not make transactions immediately available. We address these challenges and introduce techniques to aid researchers in creating trustworthy environments for individuals living with serious mental illness to contribute granular financial data in research settings.

CCS Concepts: • **Human-centered computing → Empirical studies in HCI**; • **Applied computing → Health informatics**.

Additional Key Words and Phrases: Financial technologies, fintech, open banking, privacy, mental health, bipolar disorder

> It is devastating to have the illness and aggrevating to have to pay for medications, blood tests, and psychotherapy. They, at least, are partially deductible. But money spent while manic doesn't fit into the Internal Revenue Service concept of medical expense or business loss. So after mania, when most depressed, you're given excellent reason to be even more so.
>
> *Kay Redfield Jamison*

1 Introduction

Bipolar disorder (BD) is a chronic mental health condition characterized by alternating periods of mania or hypomania and depression. During manic or hypomanic periods of elevated mood, individuals often experience increased impulsivity [10, 11, 15]. Depressive episodes are associated with comfort spending and diminished perceived financial wellbeing [16]. The financial implications of BD are significant and well-documented. Individuals with BD-1 are 50% more likely to have declared bankruptcy than the general population [13]. Illness-related financial instability has been a longstanding concern, with a 1981 survey of spouses of individuals with BD reporting financial difficulties among their primary

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caregiving challenges [18]. Indeed, risky or impulsive financial decision-making is included as a diagnostic criterion of BD [3].

Despite the substantial relationship between BD and financial instability, research has been constrained by limited access to granular financial data [6, 17]. The emergence and widespread adoption of open banking technologies presents new opportunities for gathering and analyzing granular financial data. The general public has rapidly adopted financial technologies [4, 9], although many of its applications remain designed primarily for individual use [5]. Financial data provided by open banking technologies has demonstrated its potential to inform personalized assessments and even interventions for this population. Prior work has shown that individuals with serious mental illness are receptive to third-party notifications in financial management contexts [5]. Our past research has shown that individuals living with BD reported a high degree of comfort in hypothetical financial data sharing for long-term illness management [8]. This pilot study extends these findings towards the practical application of collecting granular financial data from individuals with BD using open banking APIs in ways that aim to be trustworthy and private.

2 Methods

2.1 Study Design and Prototype Development

We developed a web-based prototype to collect up to two years of financial data from individuals living with BD. Our prototype backend was written in Python using the Django web framework [1] and interfaced with Plaid, a third-party open banking API which connects to 11,000 financial institutions. Plaid provides the underpinning technology to commonly-used applications like Venmo and Betterment [14]. We used Plaid's Transactions API [2] to collect two years of financial data. Source code for this project is available in a public GitHub repository [7].

We also collected two years of self-reported mood logs on a monthly basis using the Life Chart Method Retrospective (R-LCM), a tool developed by the National Institute of Mental Health [12]. The R-LCM allows for the creation of a historical record of illness trajectory based on recalled life events. We implemented a version of R-LCM using a Qualtrics survey in order to annotate the financial data collected from each participant. During study sessions, we recommended participants review photographs, journals, and calendars to recollect the most severe mood state they experienced during a particular month. Participants were asked to select the most extreme mood state they could recall, ranging from "mild" to "moderate" to "severe" for depression or mania. To account for the possibility of a mixed mood state, we embedded logic in the Qualtrics survey to accept logs of both states within one month.

2.2 Establishing Trust and Preserving Privacy

We took care to establish trust with participants during study sessions. Prior to obtaining verbal informed consent, a session would begin with slides detailing our rationale for this research direction and for the individual study. We then provided a description of the financial data types we collect and our technical methods in lay terms. We indicate that although we limit collected data types and take precautions to secure them, there remains a risk of data loss or breach. After describing the increased likelihood of financial instability for individuals living with BD, a member of the research team addresses their positionality by disclosing their lived experience with the illness. We then review the informed consent documentation to address questions or concerns, after which we obtain verbal informed consent.

We emphasized privacy preservation in our study design, prototype development, and technical operating environment. We deliberately limited the financial data types we collected to transaction datestamps, spending categories as identified by Plaid, and transaction amounts. We excluded fields that risked re-identification of participants or others,

including merchant names and raw transaction descriptions. To reduce security risks, access to the prototype was only made available to researchers authenticated through the university VPN. Study sessions occurred on recorded Zoom calls where participants interacted with the prototype by remotely controlling researcher computers via Zoom's Remote Support feature. To maintain the privacy and security of participants, we paused Zoom recording during participant prototype interaction. Financial data is stored in a database on university servers isolated from the public internet.

Participants were prompted for their study identifier and to authenticate with their banking institution in a private browser window to prevent login details from being stored. Once authenticated, the prototype established a temporary connection to the participant's financial institution and began waiting for Plaid to aggregate transaction data. Plaid delivers a programmatic notification once historical transaction data is ready for retrieval. As we received this notification, the prototype backend would begin retrieving paginated transactions across multiple API calls. This connection is permanently removed following the transaction data collection, often in under one minute.

3 Findings

The overall majority of participants were enthusiastic about this research direction and were very willing to contribute financial data. Several participants mentioned that managing finances during episodes was a significant enough problem that they would have contributed more data types than we requested. Several participants noted that they were comfortable contributing financial data specifically due to the lived experience of the research team. Table 1 contains a summary of our pilot study dataset.

Table 1. Descriptive summary of data collected during our pilot study. Later participants reflect our corrected API implementation as indicated by a marked increase to Total Days and more accurate, less even Transaction Count.

Participant	Total Days	Transaction Count	Accounts
110	81 days	400	checking, credit card, savings
111	233 days	300	checking, credit card
112	331 days	163	checking, credit card
113	63 days	100	checking
114	184 days	500	checking
115	306 days	80	checking
117	67 days	9	credit card
118	64 days	2300	checking, savings
119	33 days	900	checking, credit card, savings
120	29 days	1900	checking, credit card
121	156 days	700	checking, savings
122	62 days	700	checking, credit card
123	729 days	1341	checking
124	546 days	1054	checking
125	552 days	728	checking, savings

We addressed several technical challenges during this pilot study that limited our data collection during initial study sessions. First, we learned there is often a delay between transaction data being requested and when it is made available

for retrieval by Plaid. Until we incorporated the necessary asynchronous web programming methods to account for this delay, we were only able to collect transactions that were immediately available (often three months' worth). The second technical issue involved how Plaid paginates their responses during transaction retrieval API calls. We were initially making calls without including the pagination offset resulting in repeated retrieval of the same period. This limited the available transaction history for a number of participants. We resolved this issue once we became aware of the need to account for the pagination offset in each transaction API request.

4 Future Work

We will continue onto a larger data collection study (N=50) that includes validated measures of impulsivity. We will then assess the resulting financial time-series using Hidden Markov and Regime Switching models to predict the probability that an individual may be transitioning into an illness state. The findings from the above may be incorporated into the design of personalized, timely collaborative interventions to help support individuals living with BD maintain financial stability during the course of their illness.

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