RESEARCH STRATEGY
Household Income and Child Development in the First Years of Life
(Baby's First Years, Phase 2)
June 23, 2022
NIH 2R01 HD087384

NOTE: The following is the Research Strategy submitted to NICHD in June 2022 and approved and funded by NICHD. We have since completed the age-4 assessments.

PROJECT SUMMARY

Poverty puts children at risk for developmental delays, lower school achievement and educational attainment, and unfavorable labor market and health outcomes. The Baby's First Years (BFY) project is the first large-scale randomized controlled trial in the U.S. to estimate the impact of poverty reduction on children's development and health. Launched in 2018 (NICHD R01HD087384), BFY recruited 1,000 low-income mothers and their newborn infants in four metropolitan areas. Mothers were randomized to receive a monthly unconditional cash transfer of either $333 ("high-cash gift group") or $20 ("low-cash gift group") for the first 4 years and 4 months (52 months) of the child's life. Participants have been followed up annually around the children's birthdays to measure child development and family life. In this renewal, with funding already in hand for a two-year extension of the cash gifts, BFY has the opportunity to study the impact of poverty reduction for an unparalleled duration, across the first six years of life. The continuation of the project is driven by a need to understand whether continuous monthly cash transfers will improve low-income children's development at the start of formal schooling. To accomplish this, we will collect two lab-based waves of data, at ages 6 and 8. We will assess high-cash/low-cash group differences at age 6 on measures of academic achievement skills as well as cognitive, self-regulation, and socio-emotional development. We will additionally assess high-cash/low-cash group differences in measures of brain activity and stress physiology. At age 8, we will investigate whether children's learning and developmental trajectories have been altered in ways that generate persistent impacts, 20 months after the cessation of the payments. The study will also measure family contexts based on two pathways by which poverty is theorized to affect children: an investment pathway (household expenditures; maternal work; activities with children, early care and education arrangements) and a stress pathway (economic hardship; parental relationship quality, maternal mental health, stress, and parenting quality). At both ages 6 and 8, we will assess high-cash/low-cash group differences in these investment and stress pathways.

SPECIFIC AIMS

In the U.S., nearly 1 in 5 children under age 6 experiences poverty each year. Poverty puts children at risk for developmental delays, lower school achievement and educational attainment, and ultimately, unfavorable labor market and health outcomes. The extent to which increasing family income would change the trajectories of children living in poverty is often debated, but not well understood.

The Baby's First Years (BFY) project is the first large-scale randomized controlled trial in the U.S. to estimate the impact of poverty reduction on children's development and health. Launched in 2018, and supported in part by NICHD (R01HD087384), BFY recruited 1,000 low-income mothers and their newborn infants in four metropolitan areas. Mothers were randomized to receive a monthly unconditional cash transfer of either $333 ("high-cash gift group") or $20 ("low-cash gift group") for the first 4 years and 4 months (52 months) of the child's life. Early results suggested that infants in the high-cash gift group showed more high-frequency brain activity after the first year of cash gifts, in a pattern associated with the subsequent development of higher cognitive skills.

The study has also measured family contexts based on two pathways by which poverty is theorized to affect children: an investment pathway (household expenditures; maternal work; activities with children, early care and education arrangements) and a stress pathway (economic hardship; parental relationship quality, maternal mental health, stress, and parenting quality). To date, data suggest positive impacts of the cash transfers on key elements of the investment pathway, but no positive impacts on the stress pathway. This pattern may be due to the comparative speed with which monthly cash gifts can be used to purchase parental investments in children, relative to the longer timeframe needed to improve psychological wellbeing and relationships. Alternatively, it may be that the BFY cash transfers are not large enough to reduce economic hardship and maternal stress among families living in poverty, particularly during the pandemic.

With this renewal application, BFY will estimate the causal impacts of the longest-running

unconditional cash transfer in the U.S., and the only one to provide income support throughout all of early childhood—a highly sensitive developmental period. Thus, BFY will provide an unprecedented opportunity to learn whether poverty and family income affect not only early brain development, but also academic achievement, health, and behavior. In so doing, BFY will inform policy debates about the developmental consequences of economic supports. The continuation of the project is driven by a need to understand whether continuous monthly cash transfers will improve low-income children's academic outcomes at the start of formal schooling. With funding for a two-year extension of the cash gifts, BFY provides the opportunity to study the impact of poverty reduction for an unparalleled duration, across the first six years of life. To accomplish this, we will collect two additional lab-based waves of data, at ages 6 and 8. At age 8, we will investigate whether children's learning and developmental trajectories have been altered in ways that generate persistent impacts, 20 months after the cessation of the payments. We will accomplish this through the following specific aims:

Aim 1: To measure the impacts of 6 years of monthly unconditional cash transfers on low-income children's school achievement, as well as cognitive and behavioral skills.

- We hypothesize that, at age 6, children in the high-cash gift group will have higher reading and math achievement, self-regulation, and socioemotional functioning, as well as lower rates of special education and grade retention, compared with children in the low-cash gift group (Aim 1a). We expect that these impacts will be at least as large as those found at age 4. We expect partial persistence of these impacts 20 months after the cessation of payments, at age 8 (Aim 1b).

Aim 2: To understand the impacts of 6 years of monthly unconditional cash transfers on low-income children's neurobiological development.

- We hypothesize that, at age 6, children in the high-cash gift group will have more mature patterns of brain function, as well as lower hair cortisol concentrations, compared with children in the low-cash gift group (Aim 2a). We expect that these impacts will be at least as large as those found at age 4. We expect partial persistence of these impacts 20 months after the cessation of payments, at age 8 (Aim 2b).

Aim 3: To understand the impacts of 6 years of cash transfers on parental investments and stress.

- We hypothesize that, at age 6, mothers in the high-cash gift group will continue to report higher child-focused expenditures and more frequent parent-child activities, compared with mothers in the low-cash gift group (Aim 3a). We will assess whether treatment effects on the stress pathway have emerged, by testing whether mothers in the high-cash gift group report better mental health or less stress compared with mothers in the low-cash gift group (Exploratory Aim 3b). We will assess whether any impacts on investment and stress persist at age 8, 20 months after the payments end (Exploratory Aim 3c).

SIGNIFICANCE

In the U.S., nearly 1 in 5 children under age 6 experiences poverty each year.[1] This is especially worrisome because, early in life, a child's brain is remarkably sensitive to experiences that can have profound and enduring influences on subsequent development.[2] Family economic resources shape the nature of many of these experiences, yet the extent to which they affect child development is not fully understood. Our team of neuroscientists, economists, social policy scholars, and developmental psychologists is proposing to fill important gaps in scientific knowledge about the role of economic resources in child development, by renewing and extending the Baby's First Years study (BFY). BFY is the first U.S. randomized controlled trial (RCT) to test whether cash transfers have a causal effect on the cognitive, socio-emotional, and brain development of young children experiencing poverty.

The BFY intervention is a simple, monthly, unconditional cash transfer to low-income families (which we refer to as "cash gifts," because they are unconditional and funded by private philanthropy). Mothers were recruited from postpartum wards of hospitals within 1-2 days of their child's birth and were randomized to receive either $333/month (the "high-cash gift group") or $20/month (the "low-cash gift group") via a debit card. To put the magnitude of the gifts in context, the annual cash gift of $4,000 increases the baseline income in the average BFY family by 18%. As of June 2022, we will have completed four waves of data collection—primarily consisting of maternal surveys at baseline and at child ages 1, 2, and 3—with exceptionally high retention rates. In July of 2022, we will begin in-person data collection of children's outcomes at age 4.

With this renewal application, BFY will estimate the causal impacts of the longest-running unconditional cash transfer in the U.S., and the only one to provide cash transfers throughout all of early childhood—a highly sensitive developmental period. BFY was originally formulated to study the effects of monthly unconditional cash transfers on child development for the first three years of life, with the cash gifts set to be distributed for 40 months (3 years, 4 months). In response to the COVID-19

pandemic and the need to postpone in-person research activities, the cash transfers were extended for an additional year, through 52 months (4 years, 4 months), enabling us to postpone in-person direct child assessments to age 4. Now, motivated by evidence that the likelihood of unfavorable outcomes increases with the number of years a child spends in poverty,[3] we have raised additional philanthropic funding to extend the monthly cash transfers for two more years. Thus, BFY will provide participating families with monthly unconditional cash gifts for a total of 76 months (through child-age 6 years, 4 months), with two additional follow-up waves of in-person data collection proposed at ages 6 and 8.

By measuring the impacts of six years of unconditional cash support to low-income families, **this renewal will provide an unprecedented opportunity to learn whether reducing poverty shapes development, school achievement, and health in middle childhood, as children transition to formal schooling.** In the U.S. context, quasi-experimental studies of tax and transfer programs have shown that, among low-income school-aged children, higher income usually contributes to better health, higher test scores, higher educational attainment, and higher adult earnings.[4-8] Yet, past work has tended to examine income increases conditioned on or bundled with employment, complicating efforts to isolate the causal impacts of income, per se. Moreover, these studies largely focus on older children, despite the fact that young children's development is highly sensitive to early experiences in their home environments and interactions with their caregivers.[9]

With this renewal, we will also learn if cash transfers during early childhood result in lasting improvements in children's outcomes. We propose a follow-up wave of data collection at age 8, approximately two years after the cessation of the cash gifts. This will enable us to measure the persistence of impacts on school achievement, health, and development. **Finally, with this renewal, we will gain additional insight into the mechanisms that may be driving impacts on children's outcomes,** by assessing the extent to which parental investments and parental stress are impacted by the multiple years of cash supports. Our proposed renewal through ages 6 and 8 is feasible, given the proven successes of the project to date—both in terms of project implementation, including exceptionally high rates of sample retention, as well as philanthropic fundraising for the cash gifts. In sum, the extent to which reliable and consistent cash transfers during the earliest years of life will yield important and long-lasting positive impacts has not been rigorously tested in the U.S. context. Baby's First Years is designed to fill this gap.

Rigorous evaluations of conditional or unconditional cash transfer programs (CCTs and UCTs) to low-income families have been conducted in low- and middle-income countries (LMICs). These CCTs and UCTs have often produced significant—but selective—improvements in children's development, education, and health, with effects varying within and across studies.[10-12] A review of Latin American CCTs concluded that most programs result in positive long-term effects on children's schooling, but fewer positively affect children's cognitive skills, learning, or socio-emotional skills.[13] Likewise, a review of UCTs and CCTs in LMICs found that nearly all studies positively improved at least one aspect of children's mental health, but none produced positive impacts on all mental health outcomes examined.[14] Although the literature on CCTs in developing countries has begun to examine early childhood,[15-18] evidence tends to focus on anthropometric outcomes, such as stunting and related metrics of nutrition and growth.

With a few exceptions of studies conducted in the 1970s as part of the negative income tax demonstrations,[19,20] UCTs have rarely been tested at scale in the U.S. Opportunity New York City (ONYC) was a CCT designed to reward family health, children's schooling, and parental employment. It reduced family economic hardship but did not affect older children's school test scores. Unfortunately, early childhood outcomes were not considered.[21,22] Currently, several at-scale U.S. UCT evaluations are underway: A one-time $1,000 transfer delivered by GiveDirectly; a $1,000-per-month benefit for 36 months studied by Open Research; and Mayors for a Guaranteed Income providing varying benefits across 20 cities. None of the evaluation studies for these programs has published results yet, and all focus primarily on adult health outcomes.

BFY is the first study designed to provide definitive causal evidence of the impact of childhood poverty reduction on U.S. children's brain development. Developmental studies have documented socioeconomic disparities in language, memory, executive function, and socio-emotional processing[23-27] from toddlerhood through adolescence.[24,25,28] Neuroscience provides an explanatory framework for the physiological mechanisms that explain how early experiences lead to disparities in cognitive, emotional, and behavioral development and, ultimately, school achievement. Distinct brain circuits support discrete cognitive and socio-emotional skills, and thus differentiating between underlying neural systems may provide important insights for prevention and intervention.[25,29]

Neuroscience studies have found that family income is associated with the structure and function of brain regions that support key cognitive skills.[30-36] For example, several studies have reported associations between

family income and the size of the brain's surface, particularly in regions supporting children's language and executive functioning.[32,33] These associations appear strongest among the most disadvantaged families, suggesting that an increase in family income may yield greater differences in brain development among poor children compared with their more advantaged peers. Correlational studies employing electroencephalographic techniques find that young children from lower-income families tend to show less mid-to-high-frequency brain activity, and more low-frequency brain activity, compared with children from higher-income homes.[37-40] This is important because greater mid-to-high-frequency activity has been associated with higher language,[41-44] cognitive,[41,45] and social-emotional scores,[46] whereas greater low-frequency activity has been associated with behavioral, attention, or learning problems.[47-49]

Our first paper reporting the early impacts of the BFY intervention, published in *PNAS*,[50] provides suggestive evidence that UCTs may affect brain activity among poor children. We measured the differential impacts of the cash gifts on children's brain activity after just one year of cash transfers, when the BFY children were a year old. We found that infants in the high-cash gift group exhibited more high-

	High-cash gift group	Low-cash gift group
High-frequency (gamma) brain activity	Power	Power
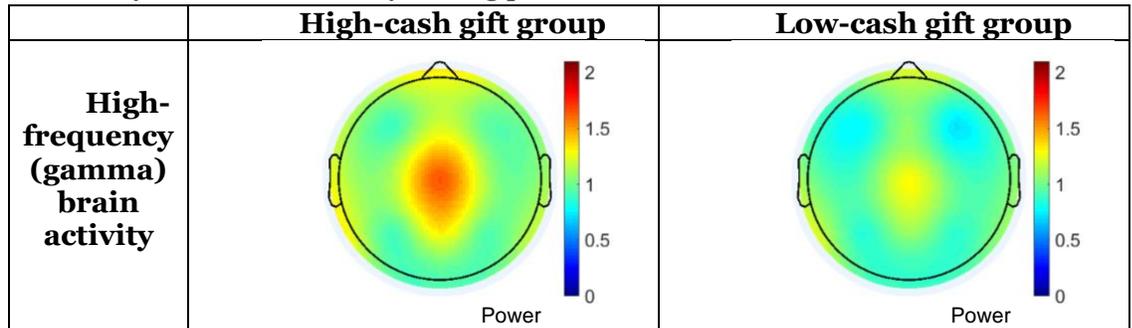
frequency brain activity (ES=.17-.26 sd), particularly in frontal and central brain regions. Prior research has linked this pattern of brain activity with the subsequent development of higher-order cognitive skills.[41-44]

Because the pandemic halted in-person data collection, the sample size was smaller than planned (n=435), reducing statistical power. Nevertheless, we interpret the weight of the evidence to support the conclusion that the high-cash gifts likely changed children's brain activity. The present renewal will provide an opportunity to test whether these brain activity differences are maintained or grow after 6 years of monthly unconditional cash support, and whether differences persist at age 8, approximately two years after the cessation of the gifts.

BFY will advance scientific knowledge by generating causal evidence on the mechanisms that explain how cash transfers affect child development. Poverty is associated with caregiving environments that are less stimulating and responsive,[51-56] but past empirical studies are largely correlational, precluding strong conclusions about the causal nature of the associations. BFY will provide estimates of the causal impacts of monthly unconditional cash transfers on key dimensions of family processes. We have followed the literature in conceptualizing these family processes as an **investment pathway** and **a stress pathway**. The hypothesized investment and stress pathways differ in their developmental mechanisms, but have the potential to be overlapping and reinforcing with similar downstream effects.[57]
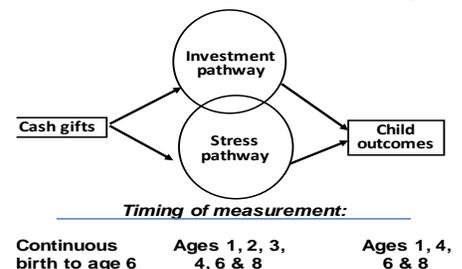
The **investment pathway** views families with greater income as better able to purchase or produce important inputs into their children's development.[58] This results in children experiencing more stimulating and enriching early environments. A predictable monthly cash transfer may help low-income parents overcome challenges in meeting basic financial needs and adapt to fluctuations in income and expenses.[59,60] It may support child development by enabling parents to meet their children's basic needs, and to invest in goods and services, such as toys and books that provide cognitive stimulation; higher quality non-parental child care and enrichment activities; and, by allowing parents to reduce or restructure work hours, potentially supporting more parental time and interactions with their child.[61-63]

Emerging BFY evidence suggests that mothers are indeed using the cash gift to "invest" money and time in their children's development. After one year of cash gifts, mothers in the high-cash gift group report higher expenditures on child-specific goods such as books, toys, and diapers (ES=.23), and report engaging more frequently in parent-child activities such as book reading and storytelling (ES=.16).[64] Preliminary analyses suggest that these impacts may persist for at least three years. In addition, at age 2, mothers in the high-cash gift group reported that their toddlers were eating more healthy foods (ES=.20). After one year of gifts, no statistically detectable impacts were found on maternal paid work, breastfeeding duration, childcare use, or household economic hardship. However, at age 2, mothers receiving the high-cash gift were less likely to report working full time (20% vs. 25%), possibly in response to the pandemic (see *"The COVID-19 pandemic and external validity,"* below).

Psychologists and sociologists also point to the ways in which economic disadvantage impairs children's development through a **stress pathway.** This pathway includes effects on parent's mental health and chronic stress,[65-68] as well as the quality of family relationships,[55,69,70] arguing that economic hardship increases parental psychological distress which in turn creates conflict and withdrawal in family relationships and results in parent-child interactions that are more negative and harsh as well as less nurturing and supportive.[56,69-71] Reducing the stress children experience may improve children's executive functioning and socioemotional skills, which are supported by neural structures and circuits that are highly sensitive to chronic stress.[72,73]

Evidence is mixed regarding the extent to which cash transfers from CCT, UCT, and other policy changes improve key elements of the family stress model. Systematic reviews of experimental international cash transfers suggest that these programs improve food security and economic well-being, and generate small reductions in family violence and parental mental health problems.[12,74-78] In contrast, U.S.-based studies of policy changes find only selective reductions in economic hardship and maternal mental health, and null to small positive impacts on the quality of parenting.[79]

Counter to expectations, in BFY we have not found early group differences in key elements of the family stress pathway (i.e., economic hardship, maternal psychological distress, maternal mental health, romantic partner relationships, parenting stress, or parenting quality).[80] Indeed, counter to hypotheses, at age 1, the mothers in the high-cash gift group reported significantly more anxiety (ES=.25), though no differences were detected at age 2 or, preliminarily, at age 3. We do not see that the cash gifts have affected mothers' marital or romantic relationship status or quality of co-parenting and romantic relationships, nor have they affected mothers' fertility or her co-residence with other family members. We will continue to track these outcomes at age 4, and with the current renewal, at ages 6 and 8.

Why the differential emerging support for the two mediational pathways? One obvious possibility is the amount of time it might take for each of the pathways to be changed by cash transfers. Participating mothers were provided with the BFY debit card with its initial monthly deposit in the hospital shortly after giving birth. Changes in expenditures can be immediate, as in the case of one mother in our qualitative sub-study who instructed her partner to go out and purchase a car seat for their trip home from the hospital. On the other hand, it may take multiple years of consistent poverty reduction for positive impacts to emerge on perceived stress, relationships, mental health, and parenting quality. With continued cash transfers over time, and with children growing older and easier to care for, changes in key elements of the stress pathway may be subsequently positively impacted by the BFY cash gifts.

An alternate explanation is that $333 per month is not large enough to bring about fundamental changes in parents' lives needed for better mental health or psychological well-being. To date, qualitative interviews with a subset of BFY mothers support this interpretation. The first set of interviews focused on experiences of the cash gifts. Mothers indicated that financial strain was acute at the time of their child's birth, and that the cash gifts were an unexpected relief, which could be put toward expenditures such as paying a utility bill or purchasing food or cleaning supplies. Over additional interviews, we also heard how the BFY cash gifts help mothers meet their parenting goals. However, the mothers continue to report a wide range of stressful experiences: financial pressures, relationship troubles, parenting challenges, natural disasters, difficulties navigating public assistance programs, racism, and discrimination, as well as health problems in themselves and their families. Many of these challenges were also magnified by the COVID-19 pandemic and racial unrest.

By providing a full six years of cash gifts, BFY will be able to provide clear causal evidence on the extent to which stress pathway processes respond to a monthly unconditional cash transfer of $333 in children's early years of life, or whether the reliable monthly BFY cash gifts are just not large enough to cause positive improvements in parents' mental health, family relationships, and parenting quality.

The enduring effects of cash transfers on child development after cessation of the cash supports is not known. Studies of CCTs, UCTs, anti-poverty programs, as well as child and adolescent interventions, are dominated by "end-of-treatment" impacts. However, in the case of UCTs and CCTs, there is an increasing consensus from studies in LMICs that receiving benefits as a child has lasting impacts on educational attainment and adult labor-market outcomes.[13] Quasi-experimental studies of tax and near-cash transfer programs in childhood suggest important long-term effects on children's subsequent achievement and adult health and employment.[4,81,82] A recent review of U.S. early-childhood education programs concluded that partial persistence of achievement impacts is common, but depends on the nature of the intervention and subsequent social and environmental contexts.[83]

In the case of the BFY cash gifts, persistence is likely to depend on the magnitude and nature of impacts on the family's behaviors and the children's developing capacities in the first six years of life. Our proposed data collection will provide an assessment of impacts on early school achievement skills, as well as cognition, behavior, and neurodevelopment, including executive functioning, socioemotional skills, IQ, and brain activity.

The family processes to be studied will include the full range of child investments, health behaviors, and relationship and parenting quality. Extending the measurement of these outcomes through the end of the BFY cash transfer period—and then beyond it—will provide a much more complete picture of the possible permanence of the benefits of poverty reduction on children's long-run health and development.

BFY findings will inform policy debates on the consequences and benefits of conditional and unconditional income support policies. Beyond its core contributions to science, BFY provides important evidence about the likely effects of tax and transfer policies on young children in the U.S. The $333 monthly gifts comprising the intervention were chosen because they are consistent with the size of income increments associated with changes in children's development and are well within the financial range of benefits of existing programs (SNAP, ETIC, CTC) that are active in ongoing debates. In 2021, the American Rescue Plan expanded the child tax credit (CTC) dramatically, both in amount and eligibility. Specifically, the CTC was made "fully refundable," such that low-income parents who did not owe federal taxes were now eligible to receive the benefit. Congress fiercely debated whether to render the expanded CTC permanent, and it continues to be a policy priority for the current federal administration. Moreover, the policy appetite for providing cash support to vulnerable families has grown enormously in other arenas. By the end of 2021, 33 state and local cash-support programs had been launched.[84] Given our early success and high retention, BFY is well poised to contribute to policy discussions of whether and how cash supports affect children and families.

INNOVATION

BFY is the first and only study designed to provide definitive causal evidence of the impact of early childhood poverty reduction on U.S. children's outcomes. With this renewal, BFY will follow children through the early grades of formal schooling. BFY is the only U.S. cash-transfer study assessing whether and how reductions in poverty causally affect child development. Our proposed extension builds upon prior experimental and quasi-experimental studies of the impacts of income changes on children's development, and complements studies offering unconditional cash to families in LMICs. It adds to these studies by offering evidence on a long-duration of cash transfer prior to the start of formal schooling.[10]

BFY will provide evidence on the extent to which cash transfers have persistent impacts. Understanding whether end-of-treatment impacts persist is of significant scientific and policy interest. It contributes to a scientific body of work about the role of early childhood and later developmental trajectories. In addition, tax and transfer programs for low-income families are routinely debated, modified, and rescinded from one political administration to the next. The proposed 8-year follow-up will provide an opportunity to examine whether the impacts of the cash gifts persist 20 months after cessation of the cash gifts.

BFY combines the best elements of rigorous social science and neuroscience research. The study combines random assignment, rigorous sampling and survey methods, and state-of-the-art measurement of parenting and other family processes, coupled with rigorous methods from neuroscience, including brain and stress physiology assessment. Employing such neuroscience methods in the context of a large social science experiment is highly innovative, and the value of the study is further enhanced by the richness of the accompanying longitudinal data.

BFY is a highly innovative and synergistic combination of funders (NIH, private philanthropy, and local government for research; private philanthropic funding for cash gifts); **advisers** (national advisory board, local community engagement boards); **and government partners** (state and local governments for data-sharing and public benefit exemptions). Unlike most other cash support studies, BFY has participants residing in four communities, which vary in terms of cost of living and generosity of public benefits, and which also have differing histories of oppression and incorporation. Moreover, prior to the launch of the study, we secured exemptions to ensure that, to the extent possible, **BFY cash gifts would not count in determining eligibility for public benefits** in those communities. In contrast, most of the current guaranteed-income demonstration programs are small, shorter-term pilot projects among specific local communities or populations, with fewer public benefit exemptions. Finally, **the quantitative research is informed by a longitudinal qualitative companion study, as well as by community engagement boards comprised of key stakeholders and champions** for the BFY mothers and their communities.

PROGRESS TO DATE

BFY Baseline Recruitment and Study Design. Birth-giving persons (who we refer to as mothers throughout the proposal) were recruited from postpartum wards of hospitals within 1-2 days of their child's birth in New York City (n=289); New Orleans (n=295); and the Omaha (n=295) and St. Paul/Minneapolis (n=121) metropolitan areas. Eligibility criteria included: (1) mother of legal age for consent; (2) household income below the federal poverty threshold in the calendar year prior to the interview, counting the newborn;

(3) infant admitted to the newborn nursery and not the intensive care unit; (4) mother not planning to move out-of-state; and (6) mother fluent in English or Spanish (necessary for the child outcome measures).

Approximately 40% of the mothers in the study self-identify as Black (non-Hispanic), and another 40% identify as Hispanic (of any race). Somewhat larger fractions of BFY mothers identify as Black (40% vs. 35%) and Hispanic (40% vs. 20%) than do corresponding fractions of low-income mothers in the cities in which they live. Although our sampling of mothers from hospitals took advantage of the random nature of the timing of births, some of the hospitals primarily served communities of color.

Mothers were on average 27 years old at the time of their child's birth. Close to half of the mothers had never been married, and a little over one-third reported living with the biological father of their infant. About one-third of the newborns were first births. The average household income of the mothers was about $22,000 and mothers averaged just under 12 years of education.

Sampling mothers from hospitals rather than community-based organizations or other agencies increased the likelihood that families were representative of low-income communities. The four sites were selected because they are diverse in terms of racial and ethnic composition of low-income residents, cost of living, urbanicity, and the generosity of state safety-net programs. We worked with state and local governments to implement administrative rule changes or pass legislation that put in place exemptions or approvals, ensuring that the mothers would not lose eligibility for public benefits because of the BFY cash gifts. As a result, the cash gifts are exempted from countable income in the determination of benefits from most relevant programs, including TANF, SNAP, Medicaid, public housing units, child care subsidies, LIHEAP, and Head Start.

Sample design, recruitment strategies, and exclusionary criteria were chosen to optimize the external validity of the sample with respect to all poor families with newborns, and to minimize the difficulty and expense of recruitment and follow-up. Clustering the sample in four medium-to-large metropolitan areas provided a geographically diverse sample that could feasibly be assessed in university research settings. Spreading recruitment evenly over 12 months smoothed the workflow. We included all families living in poverty regardless of number of children or depth of poverty, because previous studies have found positive income effects for all poor families, regardless of these factors. Moreover, it was not clear *a priori* that either families with more or fewer children—or the least poor or poorest families living in poverty—would be best able to use the money to improve child outcomes. Finally, in keeping with our goal of informing policy debates on the consequences and benefits of income support policies, the use of the federal poverty threshold best matched the population commonly targeted by U.S. means-tested social policies.

Randomization. After agreeing to participate in a longitudinal study and completing the baseline survey, mothers were randomized to receive either a large (n=400) or nominal (n=600) monthly cash gift. Random assignment occurred within-site. Baseline equivalence was successfully achieved across 30 characteristics, both for the full sample of 1,000 mother-infant dyads, and within each site.[85] The equivalence of participants on baseline characteristics has been preserved through all waves of data collection.

Cash Gift Implementation. Currently, mothers in the high-cash gift group receive monthly cash gifts of $333 ($4,000 per year) for the first 52 months of the child's life, paid on the day of the month of the child's birthday. Gifts are disbursed on an electronic debit card branded "4MyBaby."[86] With philanthropic funding, we are now extending the gifts for an additional 24 months (for a total of 76 months of cash transfers). Monthly text messages alert mothers to the distribution of funds. To eliminate any transfer-mode effect, mothers in the low-cash gift group receive $20 per month, delivered in the same way. Debit cards were chosen for the cash transfers for practical reasons (e.g., few low-income individuals have bank accounts) as well as for conceptual reasons (e.g., to preserve the unconditional cash transfer nature of the transaction, and to enable point-of-sale or ATM cash transactions).

Over 90% of the mothers gave us permission to track their card transactions. During the first 24 months, we saw nearly universal uptake and use of BFY cash gifts. We maintain a debit card helpline that provides support to mothers for any card-related issues. Transaction data from the first year of the project showed that in any given month, over 90% of the mothers in the high-cash gift group used the card. Two-thirds used the card every month. Further, most of the cash gifts were expended within days of the disbursement. The most common transaction among high-cash-gift recipients was a withdrawal of cash from an ATM (about 33% of the money). The remainder of the high-cash gift spending was spread across a variety of point-of-sale venues, with the largest and most frequent transactions occurring at large chain restaurants or grocery stores.

Progress on Original Aims, Sample Retention, and Changes Due to the COVID-19 Pandemic. Our original Aims were to measure impacts of the cash gifts on age-3 cognitive and behavioral development (Aim 1); age-3 neurobiological development (Aim 2); and parental investment and stress at ages 1 and 2 (Aim 3). The pandemic changed our study plans in several ways. First, we halted in-person data collection in March, 2020, which was roughly two-thirds of the way through the age-1 data collection. Age-2 and age-3 data

collection has subsequently been conducted via phone interviews with the mothers. Despite these disruptions, our sample retention has been excellent (n=931 mothers at age-1 and n=922 mothers at age 2). We are on track to have similarly high rates of retention at age 3 (to be completed in June, 2022). Second, to accomplish our original Aims 1 and 2, we initially planned for an in-person laboratory visit at age-3. Because this was not feasible in the pandemic context, and because high-quality measures of child development require direct assessment, we successfully raised funds to extend the cash gifts for one year, postponing the laboratory assessments of child development and health until age-4 (scheduled to begin in July, 2022). As a result, original Aims 1 and 2 will be completed at age-4 rather than age-3. However, as noted above, we have published early impacts on brain activity at age 1.[50] Original Aim 3 has been completed, with results as described above currently under review.[64,80] Public-use data from baseline and age-1 have been released through ICPSR, and age-2 data are being processed for release. ICPSR reports 1,953 data downloads to date.[87]

Mothers' Voices Qualitative Study. Eighty mothers (50 in New Orleans and 30 in the Twin Cities), chosen at random and divided equally within site across high-cash and low-cash gift groups, were recruited to participate in a qualitative sub-study comprised of 1.5- to 2-hour conversational interviews every 9 to 12 months. These data provide an important opportunity to hear directly from the mothers about what the money has meant in their lives. Interviews have focused on experiences of the cash gift, economic goals, financial products, the use of public benefits, social support, romantic relationships, parenting, adjustment to the pandemic, coping with stress, and natural disasters.[88,89] Our research team meetings include PIs of both the qualitative and quantitative studies to ensure shared learning.

Dissemination of Findings. The study and early findings have been of significant interest to scientists, stakeholders, and the general public. We have published six papers in academic journals, have five more under review, and have more than a dozen in progress. In addition, in the first three years of the study, the PIs have presented on BFY more than 135 times. The audiences have been diverse—including academic departments and conferences in social work, public policy, economics, psychology, medicine, and neuroscience. We have also given presentations to general audiences in the form of webinars and publicly broadcast talks, with more than 2 million views to date. The study has been widely covered by nearly every major U.S. media outlet. Finally, we have held briefings for state legislative and administrative staff, federal Senate and House staff, as well as the Office of Management and Budget and Department of Health and Human Services.

APPROACH

The proposed study renewal will invite BFY mothers and children to participate in two more waves of in-person data collection, at child ages 6 and 8. Data collected at age 6 will be used to estimate the impact of six years of cash gifts on children's school achievement and cognitive and behavioral skills (Aim 1); neurobiological development (Aim 2); and family processes (Aim 3). We have already secured $3.5 million in co-funding from private foundations to cover the additional 24 months of cash gifts, for a total of 76 months (6 years, 4 months). Within each Aim, we will measure the extent to which "end-of-treatment" impacts observed at age 6 persist through age 8.

Mothers and the focal child will be eligible for the age-6 and age-8 data collection if they are not permanently separated from each other or deceased (n=993 as of June 2022). As in the past, to avoid coercion, we will explain to the mother that her receipt of the monthly cash gifts is completely independent of her research participation. Although a small number of participants may decline to participate in the research, the extremely high rates of study participation to date suggest this is unlikely to be a problem.

Following the current BFY recruitment schedule, data collection will be scheduled around the time of the child's 6th and 8th birthdays, to ensure that the age-6 data collection occurs several months prior to the end of the cash gifts. As in prior waves, data collection will be spread evenly over the course of 12 months to avoid impacts of seasonal variation and to keep staff workload manageable. The data collection and sample-tracking will be managed by our PI team, in close collaboration with local site laboratory staff.

Sample Tracking and Retention. We expect to retain and collect data from at least 80% of the baseline sample at age 6, and 75% at age 8. We have collected extensive contact information to keep in touch with mothers, and we regularly check and update this information. We will stay in contact with families after the age-4 data collection, reaching out every 3 months to confirm addresses and contact information. This will be supplemented with updates through passive approaches such as checking national address change registries. This strategy has been extremely successful in maintaining high response rates over the course of the study and will be supplemented by in-person locating attempts, as needed, at the age-6 and age-8 waves.

BFY Renewal Child Outcome Measures. We will invite the mother and child to university laboratories for age-6 and age-8 data collection. Whenever possible, measures have been normed and validated among low-SES children whose primary language is English or Spanish. Table 1 shows which constructs were

collected across waves of data collection. See Human Subjects Section 4.2 ("Outcome Measures") for further details.

Child achievement and cognitive measures. We will administer tasks to assess early achievement (Woodcock-Johnson IV Broad Literacy and Math composites), non-verbal IQ (Wechsler Nonverbal Scale of Intelligence), and executive functioning (Minnesota Executive Function Scale; MEFS).

Child socioemotional development. We will administer the Child Behavior Check List (CBCL), a parent-reported measure of behavior and emotional problems. We will use a shortened version that measures attention problems and aggressive behavior.

Child schooling outcomes. We will obtain maternal report of whether the child has repeated a grade or receives special education or other services in school, adapted from the *School Enrollment and Expectations* (SEE) section of the PSID Child Development Supplement. We will also measure suspensions and related school disciplinary events.

Child health. We will measure child height and weight to calculate body mass index (BMI). We will additionally collect maternal report of the child's general health, including sicknesses, chronic health conditions, and developmental diagnoses.

Child brain activity. Many studies of brain activity in childhood rely on electrophysiological techniques such as electroencephalography (EEG) and event-related potentials (ERP).[90] These techniques measure the electrical activity of the human brain (or "brainwaves") by placing electrodes on the scalp and amplifying the signal. Changes in voltage are then plotted over time. While EEG is measured while the child is "at rest," ERP assesses the child's neural response to a particular set of stimuli, such as words or pictures, to better understand how children's brains are functioning during particular cognitive tasks.

We will collect all electrophysiological data on 128-lead, high-density Electrical Geodesics Inc. (EGI) systems using identical procedures across the four sites, as have been described in numerous studies in the co-investigators' labs.[91-102] Each lab in the four sites has prior experience collecting these measures with children from low-income families. All raw EEG and ERP data will be transmitted via secure electronic transfer to MPI Noble's lab for central processing and analysis. Resting EEG will be collected while the child sits quietly in a chair in front of a computer monitor presenting a colorful, animated display of a pinwheel. We hypothesize that, as at age-1,[50] children in the high-cash gift group will show a more mature pattern of resting EEG.[101,103,104] Specifically, we predict that the high-cash gift group will show more mid-to-high-frequency resting EEG activity, including greater frontal gamma power, relative to children in the low-cash gift group. Children's language-related brain activity will be measured by the Auditory Mismatch Negativity (MMN) ERP. We hypothesize a greater amplitude MMN to the phonetically deviant stimulus in the high-cash gift group, which has been associated with better language development.[105-109] Children's executive function-related brain activity will be measured by the Zoo Game, a computer-based Go/No-go task that has been used to examine children's inhibitory control at these ages.[100,110-113] We hypothesize that children in the high-cash gift group will have fewer false alarms, and a larger N2 ERP to no-go trials, associated with better executive function.

BFY Renewal Family Process

Measures. At ages 6 and 8, we will also obtain multiple measures of family processes hypothesized to explain the connections between poverty reduction and child development (i.e., the investment and stress pathways). Data will be obtained through surveys and interviewer observations. All survey measures have been validated in prior large-scale studies of low-income families and many have been used in BFY maternal surveys at earlier ages.

Economic resources and investment. Survey measures of the nature and use of economic resources will include families' total income, earnings, debt, savings, economic hardship, food insufficiency, and household expenditures. Our measure of total income will enable us to measure the *net* family income increased by the cash gifts, while details on income from other family members will enable us to assess how much of the increased income is shared across extended families. We are working with states to obtain administrative data on Unemployment Insurance (UI)-based quarterly earnings and state records of TANF, SSI, CCDBG child care assistance, and SNAP benefits. To date, we have data-

Table 1. Current and proposed outcome measures	Current data collection (R01 HD087384)				Proposed data collection	
	Age 1	Age 2	Age 3	Age 4	Age 6	Age 8
	Receipt of monthly unconditional cash gift					
Child outcomes						
Brain activity: Resting (EEG)	x			x	x	x
Brain activity: Task-related (ERP)				x	x	x
Math and reading achievement (WJ IV)					x	x
Executive functioning (MEFS)				x	x	x
Social-emotional health (CBCL)			x	x	x	x
Cognitive ability (WNV)				x	x	x
BMI				x	x	x
Child stress hormone (hair sample)				x	x	x
Physical health (survey)	x	x	x	x	x	x
School perf., participation, spec. ed (survey)					x	x
Family investments and stress (direct assessments)						
Parent-child Interaction (coded video)	x			x	x	x
Maternal stress hormone (hair sample)	x			x	x	x
Executive functioning (MEFS)				x	x	x
Maternal BMI (self-report)				x	x	x
School quality (administrative records)					x	x
Family investments and stress (survey)						
Expenditures: education, activities, learning materials, clothes, & technology	x	x	x	x	x	x
Health care costs		x	x	x	x	x
Parenting nurturance and self-efficacy					x	x
Harsh discipline	x	x	x		x	x
Daily routines & sleep	x	x	x		x	x
Mother's relationships: Co-parenting & quality of intimate partnerships	x	x	x	x	x	x
Maternal & household labor market participation	x	x	x	x	x	x
Household income overall & by source	x	x	x	x	x	x
Household expenditures (food, rent, transportation, internet/cell, utilities)	x	x	x	x	x	x
Household food security	x	x	x	x	x	x
Household economic stress	x	x	x	x	x	x
Maternal mental health: perceived stress, anxiety & depressive symptoms	x	x	x	x	x	x
Parenting stress, aggravation & competence	x	x	x	x	x	x
Experiences of everyday discrimination			x		x	x
Neighborhood poverty and safety	x	x	x	x	x	x

See Human Subjects Section 4.2 for more details on measures

use agreements in place or well in-process in all 4 states. These administrative data will provide us with a second source of information on income and benefit use. We have permission to collect administrative data from over 75% of mothers.

Information about the quality and characteristics of housing and residential histories will be collected from maternal surveys and geocoding data matching, which will enable us to test whether cash gifts are used to pay for moves to higher-quality housing units and/or safer neighborhoods. A separate NIH R21 proposal (PI: Tim Bruckner, University of California, Irvine) plans to link participant addresses to neighborhood dimensions of childhood opportunity (including neighborhood poverty, residential segregation, noise pollution, and proximity to healthy food outlets). This proposal scored in the 9th percentile and awaits funding pending council review. All deidentified neighborhood data will be made publicly available and linked to BFY data.

Information about parental employment and child care (current and retrospective to age 4), including the amount, type, and cost of care as well as transition to formal schooling, will be collected from maternal surveys. Surveys will also gather information about cognitively stimulating activities, learning materials, and parental time spent with children. We will ask about child enrichment expenditures as well as other major categories of spending such as housing, transportation, and food. Data on preventive health care visits, including well-child and dental visits, will be collected via maternal survey.

Maternal and child stress physiology. To obtain a direct physiologic measure of stress dysregulation, hair cortisol (capturing cumulative stress) will be collected from children and mothers. Because hair follicles accumulate cortisol continuously, hair cortisol acts as a biomarker for chronic stress of the type experienced by low-income children and adults.[67,114-116] Additionally, hair provides a measure of cortisol that can be obtained noninvasively in a single sample, free of many of the methodological challenges associated with collecting diurnal salivary cortisol.[117,118]

Stress-related processes, parenting quality, maternal health, and maternal cognitive resources. To assess the family stress pathway, information on maternal relationships, maternal stress, mental health, and

interactions with children will be collected. Survey measures will assess family stress, quality and stability of mothers' relationships with the child's father and other romantic partners, as well as maternal parenting stress, and maternal symptoms of depression (PHQ-8) and anxiety (GAD-7). During a 10-minute free play, mothers and children will be provided with three toys, and parent-child interaction will be coded for parenting sensitivity and parent-child attunement using the Coding of Attachment-Related Parenting (CARP), which has been adapted for this age-range.[119] The MEFS will be administered to mothers to measure maternal executive functioning (or "bandwidth"). We will also measure maternal physical health (self-report, BMI). State administrative data will enable us to track child protection welfare reports.

Demographic characteristics. Demographic measures which have been collected in prior waves will be updated as necessary to note any changes (e.g., family size, maternal educational attainment, marital status).

Analytic Approach. Our key aims are to evaluate the impacts of the BFY monthly cash transfers on validated measures of child development and family life. We hypothesize that, compared with the low-cash gift group, the high-cash gift group will have higher scores on measures of achievement, cognition, and behavior (Aim 1); more mature patterns of child brain activity and lower stress hormone (Aim 2); and increased maternal investments in children (Aim 3). We will also explore whether treatment effects on the stress pathway have emerged (Aim 3). Data will be collected on these measures at age 6 to assess "end-of-treatment" impacts of the cash gifts cumulatively from birth, and then again at age 8 to evaluate whether any impacts persist or newly emerge 20 months after the end of the cash transfers. All hypotheses will be preregistered.

Before conducting main analyses, all measures will be examined for psychometric equivalence across race/ethnicity and home language. In data collected at ages 1 and 2, maternal survey measures had nearly equivalent psychometric properties across race/ethnicity and language. Most analyses will focus on full-sample impacts, although we will also estimate in exploratory analyses moderation of impacts by race/ethnicity (Black vs. Hispanic), family structure at birth, and depth of poverty at birth (income-to-needs ≤ .5 or not). As explained below, estimating experimental impacts on both family processes and child outcomes is a small subset of the full range of mediational models that could be estimated.

Our basic empirical approach will be to use the survey and assessment data to compare the pooled cross-site \$333/month treatment and \$20/month control groups on outcome measures at each age. Because of random assignment, the low-cash gift group average enables us to identify the average outcomes corresponding to the counterfactual state that would have occurred for individuals in the high-cash gift group if they had not been offered the additional \$313/month. Therefore, differences in outcomes for the treatment group compared with the control group (after random assignment) can be interpreted as estimates of causal treatment effects of the \$313/month higher income (regardless of whether treatment-group participants actually use all of the funds; i.e., intent-to-treat effects).

Estimation strategy. Our approach to estimation is a simple regression framework. The "Intent-To-Treat effect" (ITT) is the estimate of the coefficient π_1 in a regression of some child or family process outcome (Y) on a dichotomous indicator for assignment (Z) to the treatment high-cash group as in (1).

(1) $Y = Z\pi_1 + X\beta_1 + \varepsilon_1$

We will adjust standard errors by site using bootstrapping methods.[120] We condition on baseline demographic child and family characteristics to improve the precision of our estimates by accounting for residual variation. As described above, we have very low rates (<1%) of "non-compliance," obviating the need for ITT vs. TOT distinctions.

For outcomes that are measured at two or three ages (e.g., EEG, MEFS, CBCL, and non-verbal IQ), we can also estimate pooled regressions using age-standardized scores. In these analyses, we will adjust for the non-independence of observation, and interact child age with treatment group (high-cash gift vs. low-cash gift). The coefficient on the interaction term provides an estimate of whether the impact of the cash differs across ages (or waves). We expect age-6 impacts will not be significantly lower than age-4 impacts, although we expect that age-8 impacts will be somewhat smaller than age-6 impacts. Nevertheless, the statistical power to detect significant age-by-treatment interactions may not be sufficient to detect small changes across ages.

To accomplish Aims 1 and 2, we will apply our regression estimation strategy to the measures of achievement, self-regulation, and socio-emotional functioning, as well as to the measures of brain activity and stress physiology at child ages 6 and 8. The coefficients obtained in our regression models will be used to quantify the causal effects of the \$313/month group difference in cash support on age-6 and age-8 child cognitive development, socioemotional functioning, brain activity, and stress physiology. We will pool data across ages as appropriate and will test for age by treatment group interactions to answer questions about the relative magnitude of impacts at ages 4, 6, and 8.

To accomplish Aim 3, we will apply our ITT regression strategy to measures of material hardship, family expenditures, food insecurity, housing and neighborhood quality, routines and time use, maternal executive

function, maternal stress and parenting practices, and maternal mental health gathered at child ages 6 and 8. Because many of these measures are the same across waves, we can again estimate pooled regressions and test for differences by using an age-by-treatment interaction term.

The investment and stress pathways are indexed by a collection of measures that may be independent of each other but that, in some cases, can be combined into summary measures. Some family characteristics, such as maternal cognitive resources, do not fit neatly into one pathway, although they may be related to both pathways. In other cases, measures might align with conceptual pathways in a complex fashion. For example, increased employment coupled with higher-quality child care may constitute an "investment," but so might reduced employment coupled with more parental care. An important first task will be using psychometric approaches such as confirmatory factor analysis to evaluate the extent to which the elements of each proposed conceptual pathway can be combined into summary measures, given measurement across differing time periods and dimensions of behavior.

We will again use a regression model to quantify the causal effects of the $313/month group difference on the family processes in each of the conceptual pathways. Examining the possible explanatory mechanisms in this way, rather than estimating a structural-equation mediation model, and has been used effectively to infer possible mediation in comparable studies.[121,122] This approach is preferred because it preserves the experimental variation in income generated by random assignment. The underlying insight is that randomization occurred with respect to receipt of the cash gifts and not on the basis of the proposed pathway mediators. With the potential for multiple mediators, a causal interpretation cannot be applied to mediational models without a very strong, often implausible, assumption that there are no unobserved confounds of the association between the mediator and outcome.[123,124] Still, the pattern of impacts can yield important insight as to which processes are likely to be operating. For example, data from age 1 through 3 suggest that several key child investments are affected by the cash gift[64] and, at the same time, there are null to negative impacts on key elements of the family stress pathways.[80]

Attrition. The greatest threat to internal validity is potential bias from sample attrition, and specifically differential attrition rates by treatment status. We have been very successful to date in reaching exceptionally high response rates (94% age 1; 92% age 2), which has the positive spillover effect of maintaining good comparability on baseline characteristics. These rates have been achieved by expending considerable efforts to track the sample and to track response rates by treatment status within site in real time.[125] We have addressed any signs of differential attrition through small, strategic adjustments in survey follow-up efforts, including the use of increased financial incentives and on-the-ground location efforts. Based on our successes to date and continued contact with mothers around the debit card use, we anticipate continued high response rates at ages 6 and 8 of at least 80% at age 6 and 75% at age 8.

Any differential attrition will be handled with analytic weights, which are able to adjust estimates for differences in observed baseline characteristics. To date, with age-1 and age-2 data, we find some non-random attrition, in that baseline reports of mothers' poor health and depression symptoms predict non-response. Analytically we have used weights to correct for these differences, but with such low rates of non-response, it is not surprising that these adjustments have had little effect on our ITT impact estimates.

We will conduct two additional sensitivity checks to evaluate whether missing data due to time-varying (or unobserved) characteristics are affecting our estimates. First, we will examine the sensitivity of our results to worst-case bounds, which enable us to bracket the true effects of our treatment without imposing any assumptions about the unobserved outcomes of participants.[126-128] A second approach to addressing the problem of missing data will be to use multiple imputation strategies with all available data (including all survey and administrative data). Multiple imputation is an appropriate method if, conditional on all observed information, data are missing at random.[129] In this case, the high rates of baseline consent to collect administrative data are an important advantage in our effort to compare survey respondents and survey non-respondents on measures such as earnings and social program benefit receipt.

Multiple comparisons. One strength of our proposal is the collection of multiple types of data—neurobiological, survey, direct assessment, and administrative—but this leads to concerns about chance findings and Type 1 errors.[130] Best-practice methods to address Type 1 errors (false positives) differ across disciplines, so we will draw from multiple approaches with the goal of ensuring that results from one approach are consistent with results from others.[131-133] Following standard practice, we will first consider the statistical significance of individual treatment effects in isolation ("per-comparison significance"). Second, we will estimate the statistical significance of the entire family of related measures in cluster groups ("familywise error rate") using Westfall-Young step-down resampling methods[133] rather than the highly conservative Bonferroni correction. Third, where appropriate, we will estimate effects of the cash gifts on constructed summary measures, as described above. The summary measure approach results in the least loss of statistical power.[131]

Statistical power. After accounting for up to 25% attrition by age 8, and in the absence of adjustments for multiple-testing, an expected sample size of at least 750 by age 8, divided between experimental (40%) and control (60%) groups, provides 80% statistical power to detect a .23 sd impact at $p < .05$ in a two-tailed test on cognitive functioning and family processes. Given the directional nature of all our impact hypotheses, it could be argued that a one-tailed test is more appropriate, in which case our 80% power minimum detectable effect (MDE) size drops to .21 sd. Analyses of age-1 data showed that controlling for baseline covariates in estimation models yielded only very small improvements to statistical power from increased precision.

Adjustments for multiple hypothesis testing have the potential to weaken our statistical power. To the extent possible, we have proposed to create indices for related outcomes that avoid these losses in statistical power and preserve our projected .23 sd MDES. The extent to which statistical power is reduced using step-down resampling multiple-comparison approaches depends on the number and covariance of outcomes, and thus is difficult to predict. Analyses of EEG and maternal survey data from the age-1 interviews found that the typical increases in MDES ranged from 25% to 50%, with larger increases for outcomes that are highly correlated with the other outcomes in a cluster. A correction of this size would increase the .23 sd MDES to between .29 and .35 sd. As a result, we have chosen to measure sets of age-6 and age-8 measures that will minimize these power losses, while at the same time maximizing the analytic value of the collected measures for the purposes of testing our key hypotheses.

The COVID-19 pandemic and external validity. BFY mothers were recruited from May of 2018 through June of 2019. In March, 2020, when we were two-thirds of the way through the age-1 wave of data collection, the pandemic was widespread. Moreover, 2020 brought profound racial unrest. Because our study was designed as an RCT, with randomization occurring within site, the internal validity of our study remains intact. Mothers in our study in both the high-cash and low-cash gift groups had similar community experiences, allowing us to causally identify the impact of the cash gifts.

As we heard from mothers in our qualitative study, the pandemic changed the context of the mothers' lives in complicated ways, bringing greater labor market uncertainty, health risks, and social isolation as well as child care and school closures. The pandemic also brought higher levels of government benefits in the form of increased food assistance, generous unemployment assistance, and government cash payments, including in 2021 a child tax credit of $3,000 or $3,600 per child, half of which was paid on a monthly basis. These contextual changes may have affected the ways in which mothers used the BFY cash gifts. During our age-2 survey (July 2020-June 2021), we asked mothers about their experiences related to the pandemic. Not surprisingly, we found that mothers were likely to report a loss of household income related to the pandemic (63%), and a similar number reported receiving federal stimulus payments (68%). About 13% of mothers reported having COVID-19 at some point. Most interesting, however, is that mothers receiving the high-cash gift reported that they were more likely to make major changes in their behavior (e.g., cutting back on work) because of the pandemic, than did mothers in the low-cash gift group (75% vs. 69%, p<.05). In the ongoing age-3 interviews, we asked questions about their receipt of federal payments, vaccination and mask-wearing. About 57% of the mothers report they are vaccinated and over 70% say they wear masks when indoors in public spaces. While the presence of COVID-19 will likely continue to impact society for the indefinite future, extending the cash gifts through age 6 will improve the external validity of the study by increasing the proportion of time that the cash gifts were received when pandemic restrictions were not in place.

Structural racism. Structural and systemic racism and other factors create and perpetuate poverty and inequity within and across generations. Poverty and violence are racialized and gendered, with impacts that are borne unequally across individuals and communities. Although always present, as we heard from mothers in our qualitative study, 2020 brought profound racial unrest following police murders of Breonna Taylor, George Floyd and others. The BFY intervention addresses limited economic resources but does not fundamentally address the structural factors that create these inequities. From our age-3 survey data, we will learn about mothers' reports of their everyday experiences of discrimination; this will help to contextualize the findings related to BFY cash gift impacts and will shed light on whether the cash gifts affect mothers' experiences of discrimination. To date, we have learned that mothers (n=831) report only moderate levels of everyday discrimination, and mothers in the high-cash gift group report somewhat less discrimination than those in the low-cash gift group (63% vs. 58% report "never" experiencing discrimination).

Timeline. The first 12-months of the project period (from August 2023 through July 2024) will focus on survey and child assessment planning, piloting and design review, and continuing to track participants. Six months are devoted to site-based staff training and review, with the first two months overlapping with data collection to allow for contemporaneous troubleshooting and quality evaluation. The 6-year follow-up data collection will begin in July 2024 (when the first focal children begin to turn 6) and will continue through approximately June 2025 (when the last focal children turn 6). The 8-year follow-up will follow a similar cycle

of planning, piloting and design review starting in August 2025; training of site-based staff for data collection and launching the 8-year follow data collection in July 2026 to continue through June 2027. Data quality will be monitored continually on a weekly basis. Preliminary analyses will occur approximately 3 and 6 months after data collection fielding has begun. Processing and analyses of data will occur 12 months after completion of data collection fielding and will include time for preparation of data files for public use (posting at ICPSR). We will meet with each site's community engagement board members once a year (for a total of 5 in each of the 4 sites over the study period). We will meet with the advisory board once a year for a total of five meetings over the study period.

Table 2: Study Timeline	
Month (child age)	*Primary Activity*
1-48 (age 5-8)	Participant Tracking
1-12 (age 5)	Cash Gifts, Planning and Piloting of Age 6 Data Collection
13-24 (age 6)	Cash Gifts, Age 6 Data Collection
25-36 (age 7)	Planning & Piloting Age 8 Data Collection, Data Analysis
37-48 (age 8)	Age 8 Data Collection, Data Analysis, Public Data Release
49-60 (age 9)	Data Analysis, Public Data Release

PI Team and Consortium of Community and Technical Advisors. This project will be led by three Principal Investigators: Greg Duncan, PhD in economics at UC—Irvine; Katherine Magnuson, PhD in human development and social policy at University of Wisconsin—Madison, and Kimberly Noble, MD, PhD in neuroscience and pediatrics at Teachers College, Columbia. Economist Lisa Gennetian, PhD; psychologist Hirokazu Yoshikawa, PhD; and neuroscientist Nathan Fox, PhD form the rest of our core team of investigators. Duncan is a member of the National Academy of Sciences and was the 2013 recipient of the Klaus J. Jacobs Research Prize. Magnuson is the director of the only federally-funded Poverty and Economic Mobility Research Center in the U.S., and is an elected Fellow of the American Academy of Social Work and Social Welfare. Noble was awarded the 2021 American Psychological Association Award for Distinguished Contributions to Psychology in the Public Interest and is an elected Fellow of the Association for Psychological Science. Working together for over 10 years, the team has successfully implemented the BFY study, and has partnered with neuroscientist co-Is in each site to prepare to collect data at age 4 (ongoing study) as well as at ages 6 and 8 (proposed renewal study). These Site PIs are Timothy Nelson, PhD, and Jennifer Nelson, PhD (Omaha); Michael Georgieff, MD (Twin Cities); and Sarah Black, PhD (New Orleans). Noble leads the NYC data collection.

A multidisciplinary advisory board of scholars will provide feedback over the duration of the project (see letters of support): Orazio Attanasio, PhD (Economics, Yale); Flavio Cunha, PhD (Economics, Rice); Kathryn Edin, PhD (Sociology and Public Affairs, Princeton); Philip Fisher, PhD (Psychology and Neuroscience, Stanford); Brenda Jones Harden, PhD (Child Development and Social Work, University of Maryland); Charles A. Nelson III, PhD (Neuroscience and Pediatrics, Harvard); Krista Perreira, PhD (Social Medicine, UNC); Charles Zeanah (Psychiatry and Pediatrics, Tulane); Stephanie Jones, PhD (Child Development and Education, Harvard); Isaac Petersen, PhD, (Psychological and Brain Sciences, University of Iowa); Dawn Witherspoon, PhD (Psychology, Penn State). We consult with the advisory board at a yearly group meeting and in smaller groups on an as-needed basis. The range of key topics that they have provided input on to date include instrument or assessment selection, analytic data analysis decisions, strategies to improve sample retention, as well as framing and interpreting qualitative and quantitative findings.

Summary. Our team of neuroscientists, economists, social work scholars, and developmental psychologists proposes to extend the first U.S.-based experimental test of unconditional cash transfers in the first years of life. Results will provide definitive evidence about the nature and magnitude of causal connections between family income and achievement, development, and health through the start of formal schooling. Moreover, by collecting data approximately two years after the cash transfers have ended, we will provide evidence of the extent to which any impacts persist over time, informing our understanding of whether early childhood income support has the potential to change children's long-run developmental trajectories. Beyond core contributions to both neuroscience and social science research, the proposed project will provide unparalleled scientific knowledge to inform the design of numerous tax and transfer policies aimed at low-income families with young children.