When Does it Count? The Timing of Food Stamp Receipt and Educational Performance

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Abstract:
The impact of poor nutrition has been established as an important determinant of learning and achievement among school aged children. It has also been demonstrated that the single monthly treatment of food stamps leaves meaningful nutritional deficiencies in recipient households during the final weeks of the benefits cycle. This paper exploits detailed administrative data on standardized math tests scores and randomized food stamp receipt dates to allow us to measure the impact of these low nutritional periods on student performance. Our main results are that scores are notably lower when the exam falls near the end of the benefit cycle and when food stamps arrive on the four days immediately preceding the exam. While both boys and girls experienced a similar penalty with receipt near the end of the cycle, the effect from receipt just prior to the exam appears to be partially explained by a large negative effect associated with weekend receipt, which coincides with the four days prior to the exam, that is concentrated among African-American boys. Our results provide evidence that households do not sufficiently smooth consumption and that this has measurable effects on student performance. The fact that weekend receipt differs suggests a behavioral response from households beyond food insecurity that also has meaningful effects.

Keywords: SNAP Benefits, Educational Outcomes, Consumption Cycles

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Introduction and Background

The Supplemental Nutrition Assistance Program (SNAP) provides assistance to over 40 million Americans and is the largest safety net program designed to alleviate hunger. Not surprisingly, there is a substantial literature on the effectiveness of the program on relieving food insecurity and providing an adequate diet (Daveney and Fraker, 1989; Fraker, 1990; Daveney and Moffitt, 1991; Gunderson and Ziliack, 2003, Schmidt, Shore-Sheppard and Watson, 2015). However, there is a growing body of evidence that low-income households do not effectively smooth their consumption throughout the month and that the timing of benefit receipt affects consumption (Wilde and Ranney, 2000; Shapiro, 2005; Mastroubini and Weinberg, 2009).

Related, there is considerable research establishing a link between adequate nutrition and health outcomes (Gundersen and Ziliak, 2015 provides a survey of recent literature). Given this relationship, it is not surprising that food insecurity has been shown to have deleterious effects on learning (Glewwe, Hanan and King, 2001, Winicki and Jemison, 2003). Additionally, food insecurity has been shown to affect student performance in school along a variety of non-cognitive dimensions. In particular, food insecurity is associated with worse social skills (Jyoti, Frongillo and Jones, 2005), school engagement (Ashiabi, 2005) and classroom behavior (Howard, 2011). Further, the timing of benefits has been shown to affect disciplinary rates (Gennetian et. al., 2016).

Together these findings imply that the timing of bouts of food insecurity created by the lack of consumption smoothing observed during the SNAP benefits cycle might be associated with reduced cognitive performance, behavior, etc., and subsequently might affect student performance.

In this paper we estimate the effect of food stamp timing on math test scores using individual-level administrative data from the state of South Carolina. These data include the universe of all students in South Carolina whose families receive food stamps, and allow us to match food stamp receipt date with test dates and subsequent performance measures. Further, we can track the same students over time, so we are able to investigate how different food stamp timing relative to exam dates impact the *same* student over time. Our main results indicate that student performance is negatively impacted when a student's household receives benefits a particularly large number of days before the exam. Further, estimates show there is a strong negative association with receipt of food stamps on the four days prior to the exam and exam scores, which is partially attributable to receipt of benefits on weekends (which occur three and four days prior to the exams). While the effect of the exam falling late in the benefit cycle is common across male and female students, the magnitude is much larger among African Americans. The effect associated with receipt in the four days prior to the exam is driven by African American boys. Further, within this group, weekend receipt seems to be the most prevalent factor. Placebo tests show that all of the results vanish when we randomize the SNAP benefits schedule to inaccurately reflect the actual treatment observed by students. The lack of any effect under these circumstances indicates that the main findings are not an artifact of some correlation between the set of dates in a particular year and some unobserved factor correlated with exam performance. Given the results in the peer effects literature on peer composition and performance, particularly for mathematics (for example, Boucher, et.al. 2014), we also investigate how the share of a school's recipients that receive benefits on a weekend or have particularly long waits may impact student performance. While not statistically significant, estimates are suggestive that the share of the school that receives benefits on a weekend may also be associated with negative effects on performance, even when accounting for the actual individual's receipt date. While variation in this school level measure is limited, outcomes indicate that these might be negative spillovers across the student body.

This paper is related to a contemporaneous paper by Gassman-Pines and Bellows (2017), who look at the timing of food stamp receipt and test scores during 2012 in North Carolina. Using cross-sectional variation for identification, they find that student performance improves as receipt is further from the exam date until around three weeks prior to the exam and then declines. This specific finding is qualitatively similar to our findings regarding particularly long waits. However, we do not find the same positive relationship between days since receipt and the exam date. Further, our main identification strategy is to use *within student* variation on receipt date timing relative the exam date in addition to the identification from random assignment of receipt date over a thirteen-year period, which allows us to control for any confounding individual effects.

Our results contribute to a number of literatures. First, these findings add additional evidence on the relationship between safety net programs, nutrition, and testing.[1] Much of the previous work has focused on how school initiated assistance affects student performance. In particular, school breakfast programs have been a source of numerous prior studies. Notably, Leos-Urbel, et. al. (2013) find that free school breakfast programs increase participation in school breakfast even among those that were previously eligible for free breakfast, but have little impact on test scores. While, Frisvold (2015) finds a somewhat contradictory result that expansion of free breakfast programs does increase achievement.[2] Perhaps most telling is the responses of schools to increased pressure to perform well on standardized tests. Figlio and Winicki (2005) find that in response to increased scrutiny on exam performance, that schools increase the caloric value of meals on exam days and that this leads to improvements in performance. This is important in the context of our results, in that schools might be actively working to reduce the impact of long test date intervals by providing free breakfast (through PTA organizations) or manipulating the school's menus. This might mute the effect of increases in the number of days since receipt on exams. Our results suggest that while this might be possible to some degree, there remains a negative effect associated with particularly long intervals between receipt and exam dates.

We also contribute to the literature that studies high frequency consumption patterns. Under the permanent income hypothesis, households should be able to smooth their consumption in response to expected income receipt. Thus, the timing of anticipated income should not affect consumption or behavior. Nonetheless, there is substantial evidence that the timing of transfers (Stephens, 2003) and pay (Stephens, 2006) affects

[1] See Meyerhoefer and Yang (2011) for a review of methods and mechanisms for evaluating the link between safety net programs and health.
[2] See Hoyland, Dye and Lawton (2009) for a review of the effect of breakfast on performance.

patterns of consumption. Further, numerous papers have found this phenomenon in food stamp recipients. Perhaps most notably, Shapiro (2005) documents a 10-15% decline in caloric consumption across the benefit cycle. Wilde and Ranney (2000) also document a decrease in consumption as well as a dramatic change in expenditures. Declines in expenditure across the benefit cycle are also found in Wilde and Andrews (2003) and Hastings and Washington (2010). Both Shapiro (2005) and Mastroubini and Weinberg (2005) suggest that these results are most consistent with households that are extremely impatient. Recent work from Carvalho, Meier and Wang (2016) bolster this with evidence that households exhibit more present bias in decision making just before paydays.

Utilizing within-student variation, we show that students with particularly long intervals between exam date and benefit receipt perform worse. This provides evidence that households do not effectively smooth consumption. Further, by showing that this has an adverse impact on test scores, we demonstrate that the failure to smooth effectively can have important impacts on outcome measures of public interest.

We also contribute to a growing body of research, which shows that there is a behavioral response to receipt beyond just the timing of purchases and consumption. Prior work has shown that the timing of benefit receipt is associated with higher drug related hospitalizations (Dobkin and Puller, 2007) less crime (Foley, 2011), lower drunk driving fatalities during weekdays (Cotti, Gordanier and Ozturk, 2016) and that weekend receipt elicits differences in the composition of purchases (Castellari, et. al., 2016). We find that the receipt of food stamp benefits on the four days prior to the exam, results in lower test scores. One potential mechanism for this effect may be through increased alcohol purchases on weekend receipt. Castellari, et. al. (2016) finds that recipient households not only are more likely to purchase beer when receipt date is on a weekend, but that aggregate monthly purchases of beer are higher. This is also consistent with Cotti, et. al. (2016), which finds a decrease in drunk driving fatalities on receipt date, but only when receipt was not on the weekend. If weekend receipt is associated with increased risky behaviors by parents (such as alcohol consumption), this could lead to negative spillovers on students that show up in student test scores.

These results also have important and implementable policy implications. First, given the further evidence that families have difficulty smoothing consumption, distributing benefits twice in a month as opposed to just a single day might improve welfare. Given that this lack of smoothing has implications for student performance, this might also suggest that it is in the public interest to do more to help families smooth consumption levels throughout the month. Second, in consideration of prior work that households purchase greater amounts of alcohol when benefits are distributed on a weekend and that weekend receipt corresponds to a greater number of drunk driving fatalities, the fact that this is also associated with lower test scores among students, suggests that the public health benefits of restricting benefit distribution to weekdays might be significant. Of course, this could have the deleterious effect of slightly increasing the length between benefit receipt dates in some households. Additionally, it may be the case that other public benefit programs, besides SNAP, may also have behavioral responses to receipt that warrant further study.

The paper is structured as follows: section 2 describes the data, section 3 presents the econometric specifications, section 4 comprises our main results, section 5 looks at the robustness of the results and extensions, and section 6 discusses the results, possible mechanisms and concludes.

Data

The primary data for this analysis comes from the South Carolina Department of Education, and comprises test score information for students in all of the elementary and middle schools during the years 2000 to 2012. Each year students in grades 3 through 8 were given a statewide mathematics assessment. From 2000 to 2008 students were given the Pre-Admission Content Test (PACT), while from 2009-2012 they were given the South Carolina Palmetto Assessment of State Standards (SC PASS) test. These data are then merged with an administrative database on food stamp recipients. The scores, for every student who is in a food stamp receiving household during the testing month of that year, were provided by the Department of Education. The date in the month that a SNAP household receives benefits was provided to us by the Department of Social Services.[3] Thus, a student who is in a household that receives benefits across multiple years will show up in the data each year the household is on food stamps. Additionally, we are provided with information on the child's race, gender, grade, a school identification number, and an additional 65% sample of test scores for students in non-recipient households. In total, we have scores from 70-80% of the total number of students, depending upon the year. Test scores are then normalized based on the scores of the recipients and this subset of non-recipients, such that the mean of all scores (not just recipients) is zero and the standard deviation is one. Since we only have scores for 70-80% of students, we cannot assume that this was the true distribution of scores. However, we were able to compare the raw scores by grade for our data to scores of a universe of all students test scores for the year 2008.[4] The means and standard deviations are almost identical, indicating that the standardization is likely the same as if we had the universe of scores (see Appendix Table 1). The non-recipient households are only used in the standardization of scores.

For the years in our data, benefits are distributed each day between the 1st and the 10th of the month based upon the last digit of the recipient household's case id.[5] The last digit of the case id is randomly assigned by the South Carolina Department of Social Services, and, as expected, the distribution of benefits is nearly perfectly uniform across the first ten days (see Appendix Table 2).

During the period we study, the exams for math are, with one exception, given on the Wednesday[6] during the second school week in May.[7] Given knowledge of the exact exam date and SNAP distribution date for each student in each year, we can then determine the number of days between household receipt of food stamps and the date of the test for each

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[3] We thank Sarah Crawford, Veronica Watson, and Mohammad Salaam of the South Carolina Revenue and Fiscal Affairs Office for matching the data and removing identifying information.

[4] For the years 2009-2012, we are also able to compare the mean and standard deviation to the true mean and standard deviation, but not by grade level. The mean and standard deviations are again almost identical for each year.

[5] During the time period under investigation SNAP households receive benefits electronically exactly on their assigned date of receipt via their Electronic Benefits Transfer card (weekends included).

[6] In 2008, the math exam was administered on Thursday rather than Wednesday.

[7] Starting in 2014-2015, students now take an online version of the exam during a specified testing window.

child. Since benefits are distributed on one of 10 days in South Carolina, but the exam date is common for all students, the number of days since SNAP receipt takes 10 values each year. The actual possible values that days since receipt can take, however, varies by year as the calendar date of the test changes relative to the fixed distribution dates.

Figure 1: Annual Distribution of Number of Days between Last SNAP Receipt and Date of Math Test

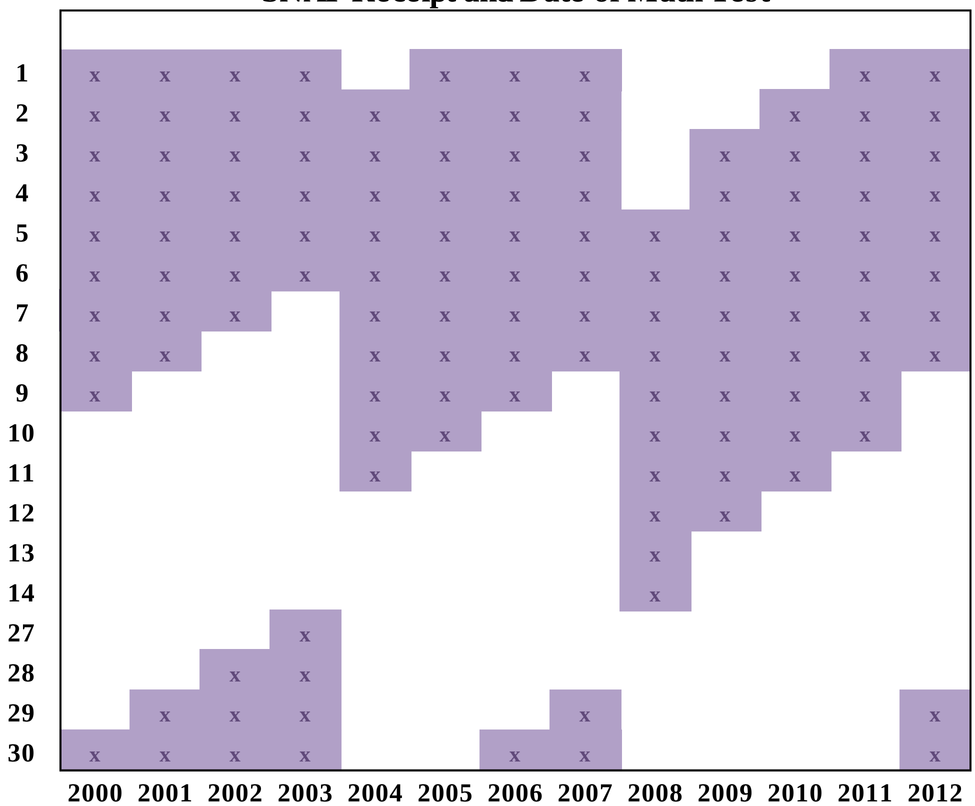


Figure 1 above shows the distribution of the values that the number of days since SNAP receipt and the date of the exam takes in each year. Note that someone who receives benefits on the day of the exam is treated as having 30 days since receipt of benefits (as it is unlikely that the household could use those benefits prior to school starting that day). It is also worth noting that some values will never appear in our data. In particular, because of the timing of SNAP distributions and exam dates, in no year does anyone have 15 to 26 days between receipt and test date.

For a given student, the number of days since receipt will generally change each year as the test date moves with the calendar, but the household receipt date does not. For example, the exam date may be May 8th one year and May 9th the next, a particular households SNAP receipt date will generally remain constant (e.g. May 4th).[8]

One further note about the number of days since receipt is that each value corresponds to a particular day of the week. That is, whenever the days since receipt is equal to 1, that is someone who receives benefits on a Tuesday. While days since receipt of 3 or 4 represents receipt on the weekend prior to the exam.[9]

[Table 1]

The summary statistics for the variables used in this analysis are presented in Table 1.

Econometric Specification:

Given the nature of our data, there are many sources of variation that we could utilize in this investigation. First, since each individual's case digit is assigned randomly, the variation in receipt dates relative to the exam date is completely exogenous. Next, each year the possible values of the "days since receipt" variable changes, providing further variation. Lastly, we observe students each time they are in a benefit-receiving household, thus we have variation in the number of days between benefit receipt and the exam date within the same student. Given the strength of utilizing within student variation for clear identification, we will focus on this empirical approach.

Our main individual fixed effects models on student performance for all students who receive SNAP benefits during the period of observation are as follows:

[8] However, if the household must re-enroll in the SNAP program, they will receive a new case id (also randomly assigned) and thus have a potentially different receipt date, which we also exploit for additional variation.

[9] In 2008 the PACT exam was given on Thursday, rather than Wednesday, so a value of 3 would represent a Monday, rather than Sunday in this year. Results are robust to excluding 2008 from the analysis.

$$Y_{istg} = \beta_0 + DAYS_{it}\beta_M + \gamma_s + \delta_{gt} + y_i + \varepsilon_{istg}$$

where $Y_{ist}$is a the standardized student's exam score (Z-score) on the mathematics section of the PACT or SC PASS exams, for individual i in school s during year t. $DAYS_t$ is the number of days since a particular student's household received SNAP benefits (as described in the data section), or will be a vector of dummies accounting for days since receipt or groups of days since receipt (as will be described in detail below). School-specific fixed effects are denoted by γ_s, and absorb time-invariant differences in exam score patterns across schools. δ_{gt} are grade-level by year fixed effects, which account for trends in exam score performance that are common to each grade-level for each year. β_0 is a constant coefficient and ε_{istg} is the error term. In order to account for the non-independence of observations from within the same individual, we cluster all standard errors in all models by individual, although results are robust to alternative clusters (e.g. school).

As discussed above, our empirical approach capitalizes explicitly on the variation in days since benefit receipt within the same students over time. This variation is mostly from changes in the test date each year relative to the fixed receipt date, but some variation can also occur due to changes in a household's case id, which impacts SNAP receipt date as well. To explicitly identify the model from this source of variation we have also included individual fixed effects (y_i) into equation (1). As this approach eliminates any remaining confounding unobserved heterogeneity across students it will provide the cleanest identification.[10]

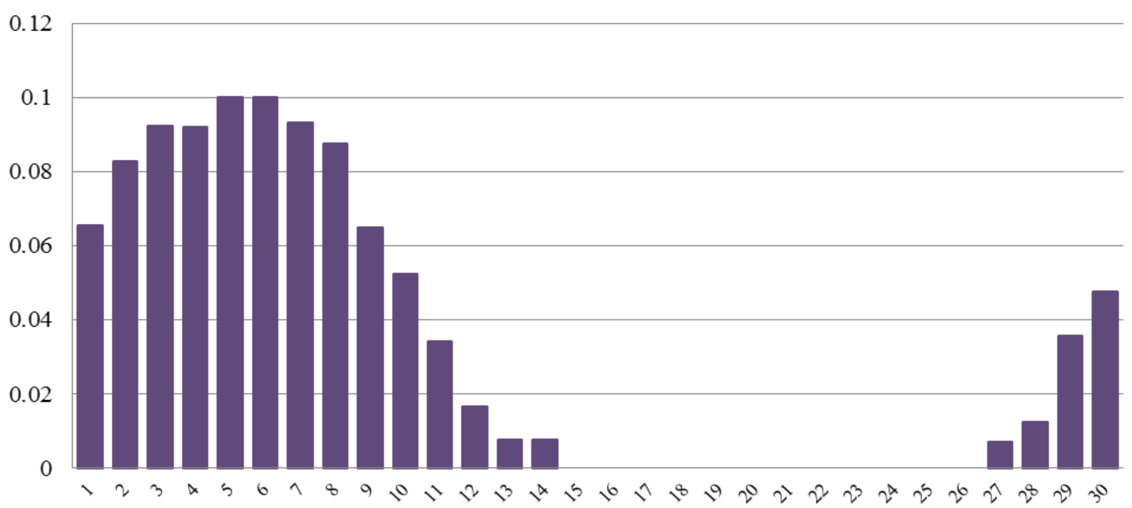
[10] While an individual fixed effect specification accounts for persistent differences in exam performance between students over time, and, as such, capitalizes on a quite powerful source of identification, there are limits in this context. First, we are able to observe the *DAYS* variable for students in years in which their families are in the SNAP program, but not all households stay on food stamps throughout the time frame, so for a group of the students the number of times we see them may be limited. The average number of appearances in our data is 2.9 and the standard deviation is 1.1. Second, we have a limited number of changes across some of the treatments. For example, usually an individual who received benefits three days prior to the exam will receive benefits two days prior in the following year. Thus, for some students, if we don't observe them a sufficient number of times, there will be small changes within the *DAYS* variable. That said, for the values associated with particularly long waits between receipt and exam date, this is much less of a problem, as there are many more changes to capitalize on in the data. Moreover, our results are robust to focusing the sample on students who appear in the sample more frequently.

General Results

While it is natural to think of the explanatory variable as a continuous measure of days since benefit receipt, there are a number of reasons why this is not appropriate for this context. Most importantly, the actual distribution of the values of days since receipt limits the validity of using days since receipt as a continuous variable.

Figure 2 below depicts the histogram of the treatment variable "days between SNAP receipt and exam date" for the 2000 – 2012 time period. Notice that the treatment variable is not uniform across the month, but rather always less than 15 days or more than 26, with most of the treatment occurring relatively close to or quite far from the exam date. Further, it can only take certain values in certain years.

Figure 2: Frequency Distribution for Days between Last SNAP Receipt Day and date of Math Test



There are also a number of theoretical reasons why a continuous treatment of days since receipt may not be appropriate. In the aforementioned literature on household consumption patterns, typically the month is divided into weeks following receipt[11], as the marginal effect of a single day is not necessarily the treatment of interest. If household caloric

[11] Grouping the days by weeks is presented in the section that follows.

consumption only declines at the end of the month when households have exhausted food resources, then there may be no effect of marginally increasing the number of days from receipt from, for example, 8 days to 9 days. It is also possible that the time frame that is most relevant is actually the previous week before the exam when exam reviews are performed or that weekend receipt matters.

Nonetheless, we estimate the effect of days since receipt with school fixed effects and without.[12] We find a very small, but statistically significant negative relationship between days since receipt in the individual fixed effect model. The results are available in Appendix Table 3.

In our attempt to identify the ways in which timing might affect performance, we instead begin by estimating the impact of each number of days between SNAP receipt and the exam separately. Specifically, we include a vector of dummies accounting for days since receipt in Equation (1), where the omitted day is the day with the average test score closest to the mean. Results are presented in Table 2 and show two interesting patterns or clusters of effects. First, we see a clear negative effect on test performances related to receiving SNAP benefits more than 26 days before the exam, indicating that significantly long waits meaningfully impact student outcomes. Second, estimates indicate that SNAP receipt on the four days directly prior to the exam (which corresponds to Saturday through Tuesday)[13] also demonstrate a negative, albeit weaker, impact on student performance.[14]

[Table 2]

Next, given the clustering of these effects into two distinct sets of days, we group our treatment variables into dummies that correspond to receipt during particular windows where the estimates are very similar and adjacent in time. This allows for days within the

[12] This specification is the most similar to Grassman-Pines and Bellows (2017). They find a statistically significant and positive relationship from this analysis, although their estimation is based on one year of data.
[13] In 2008 the PACT exam was given on Thursday, rather than Wednesday, so for this year days range from Sunday to Wednesday.
[14] Results are robust to reducing the sample to only those students that are observed multiple times.

same grouping to have the same effect. This approach also only exploits variation in moving from one cluster of days to another cluster of days as opposed to changes from moving from, for example, receipt 27 days prior to the exam to receipt 28 days prior to the exam. This is a more direct comparison of related days since receipt, and provides a more intuitive and logical framework for discussing potential mechanisms, as such, it is our preferred set of specifications. Our initial groupings are the four days prior to the exam[15], the days that are 5 to 14 days before the exam, and the "long wait" gap of more than 26 days before the test.[16] Results of these groupings are presented in column (1) of Table 3 (with 5 – 14 days as the excluded reference group) and, as expected, present the same inference shown in Table 2, with SNAP treatment directly before the exam or many weeks before the exam negatively impacts outcomes.

Given the behavioral effects surrounding possible weekend receipt of SNAP benefits that is referenced in the Introduction, in column (2) of Table 3 we split the "four days prior to the exam" group into two smaller groups. The first is receipt in the weekdays prior to the exam during the exam week (Monday and Tuesday in each year except 2008, which is Monday through Wednesday).[17] The second is the weekend prior to receipt (3 and 4 days before exam), hence allowing for an explicit examination of potential weekend effects. As in column (1) the days between 5 and 14 days and receipt that occurs more than 26 days before the test are the remaining treatment windows. As can be seen in Table 3, we observe negative effects resulting from both weekend before the exam receipt and distribution immediately prior to the exam, although the latter results are marginally significant. While, there does not seem to be any difference between receipt in the two days prior to the exam and receipt in the weekend prior to the exam in this specification, the separation of these first four days into distinct windows of treatment will present interesting differences in other specifications.

[15] Results are robust to grouping days 1 through 5 together as well.
[16] The "excluded" group is treatment between 5-14 days since SNAP receipt. Also note, no students are treated between 15-26 days in the sample.
[17] Because the 2008 PACT exam was given on Thursday, rather than Wednesday, the treatment windows are one day longer in this year. For example, "weekdays prior to the exam during the exam week", which is otherwise always 1 to 2 days prior to the exam, includes 3 days before exam for the 2008 sample. Results are robust to excluding 2008 from the analysis.

[Table 3]

The size of the individual fixed effects estimates presented in Tables 2 and 3 suggest that when a student's family receives their SNAP benefits more than 26 days before the exam the same student performs between 1.4 and 4.5 hundredths of a standard deviation worse than they would if treated much closer to the exam date. The effect from treatment on days directly before the exam ranges from 0.5 to 1.9 hundredths of a standard deviation. While the magnitude of these effects seems small, there are a number of reasons why it is economically significant. First, if we consider that the gender gap between students is approximately 7.4 hundredths of a standard deviation, and that going from a school with a poverty rate between 40 and 50 percent to a school with a poverty rate between 50 and 60 percent is associated with a gap of 7.3 hundredths of a standard deviation, then the impact of long wait treatment on performance is equivalent to between 1/5th and 3/5^{ths} of the observed gender gap in mathematics and similarly equivalent to attending a meaningfully lower income school. Second, these estimates are likely attenuated by policies that schools can pursue to ameliorate food insecurity in the days that lead up to the exam dates. In particular they could implement school breakfast programs or alter the composition of lunch menus.[18] Last, and most importantly, these effects are capturing the impact on student performance from receipt in just that one month. If student performance is indicative of the ability to learn, then these results suggest students have greater difficulty learning late in the benefit cycle (or after weekend receipt) in the one month measured. However, if we consider that there are four or five days in every month for every SNAP student where it has been more than 26 days since receipt of benefits (and an average of three months each year with a weekend receipt), if a child has reduced learning abilities on each of those days, that affects a substantial portion of the year. So, the cumulative effects across the course of the year on each SNAP student could be quite large and explain an

[18] We don't observe whether students qualify for free/reduced lunch, but it is very likely that all SNAP recipients qualify for such benefits and, hence, there is no meaningful variation in eligibility from this policy within the SNAP recipient population in our data.

important part of the learning gap that persists between low and high income students, all else equal.

These two effects are also noteworthy because they correspond well with other findings regarding general household behavior and SNAP receipt. Specifically, several papers have shown that due to poor income smoothing within the SNAP cycle, many SNAP households suffer meaningful caloric declines during the last week prior to their next monthly receipt of benefits. Hence, such late cycle caloric deficiencies would fit the negative performance pattern we are observing for students treatment many weeks before the exam. Moreover, recent research on the timing of food stamp benefits has also shown that the composition of within household purchases includes more alcohol when SNAP receipt occurs on a weekend (Castellari et. al, 2016), which may explain the similarly negative effects on exam performance observed within students. That is these results are consistent with a two-fold story that food stamp receipt timing affects not just how much the recipients are eating, but also the composition of purchases and household behaviors.

Robustness Tests and Extensions

Placebo Test

While the SNAP receipt date for each individual is random, the set of receipt dates relative the exam varies across years; thus, it is possible that there is some correlation between the set of dates in a particular year and some unobserved factor correlated with the exam scores that confound our estimation strategy. That is to say, we could have a misspecification problem where it is not the particular individual receipt date that matters, but something correlated with the set of possible dates. Given the exogeneity of the “days” variable, such a problem is highly unlikely. Yet, we can conduct a true placebo test to identify if a problem exists. Specifically, to test for this possibility we randomly assign a new “pseudo” case number for each individual that is receiving food stamps.[19] From this random pseudo number we use the same process the state of South Carolina uses in assigning our placebo receipt date to each household. Since the case pseudo id is preserved over time, we are able

[19] Since we are generating a treatment we also do this exercise for non-recipients as well. No significant relationships are found. Results are available upon request.

to replicate the transition pattern from year to year that is observed in the actual data (only inaccurately assigned across students). For example, if the last digit of the random pseudo case number is a one, then we replicate the pattern of days since receipt for a household assuming that they received benefits on the first of the month each year, instead of the actual receipt date. We then perform the same analysis as presented in Tables 2 and 3 on the effect of numbers of days between SNAP treatment and the exam[20], as well as on our different receipt windows, using this randomly computed receipt date as our treatment variable. In particular, as we are now assigning completely random and incorrect[21] SNAP receipt days to each household, we should not see a measureable effect on our *DAYS* variable, as the number of days between when the student received benefits and the exam is no longer accurate. To observe otherwise would call into question the results presented in Tables 2 and 3.

[Table 4]

Table 4 reports the results of this exercise. The effect of the pseudo receipt date is small and insignificant for all receipt windows in all specifications. Further, the sign of the coefficients does not follow the same pattern as in Tables 2 and 3. Thus, we can rule out the possibility that it is the set of receipt dates that matters. Instead, given that the true receipt date is randomly assigned as well, it must be the actual receipt date for each recipient that drives our results.

Sub-groups: Sex & Race

To consider the possibility of differences in impact by sex and race, we perform our main analysis separately for boys and girls, for African-American and white students separately. Table 5 reports the results of this analysis, with Panel A presenting results with the four days preceding the exam as one group and Panel B presenting the results with these four

[20] The excluded day is the 5th, which is the day where the average score is closest to the overall mean based on the random day assignment.
[21] Of course, around 1/10th of all recipients will be randomly assigned the correct date by chance.

days broken out by weekend (3 and 4 days before exam) versus weekday (1 and 2 days before).

[Table 5]

In looking at these results, the effect upon the African American sub-sample is notably larger. In particular, we see that the results of this analysis are qualitatively similar to the results presented in Table 2; however, the point estimate on the effect of weekend receipt is significantly larger. The effect from long waits on white students exhibits a similar pattern as Table 2, although they are not statistically significant. An analysis with interaction terms between race and the treatment variables, however, reveals that the effect of long waits is not statistically different between white and African American students (not shown). Receipt in the four days prior to the exam, on the other hand, is small and insignificant for all groups except African-American males. When this is broken apart into the two days prior to receipt and the weekend prior to receipt (panel B), there does appear to be a persistent and negative effect of receipt in the two days prior to receipt across all groups, although not statistically significant. However, the effect of weekend receipt is very large and statistically significant only for African-American males. These outcomes suggest that there are differential impacts based on race and gender, particularly with regard to weekend receipt. This could be because differential family structures associated with race and gender are associated with a differing impact. Alternatively, it could be that there are spillover effects within a school. While we control for school level fixed effects, it might still be the case that school characteristics affect the mechanisms at work. For example, in a school that is relatively wealthier there may be more guidance counselors and support staff that help students deal with food insecurity. Given the degree of segregation across schools, the school specific fixed effects might not capture this dynamic. Additionally, there might be a difference in household behavior/dynamics in households with boys as opposed to those with girls. Cotti, et. al. (2016) and Castellari et. al. (2016) both demonstrate differences in adult behavior when SNAP treatment occurs on the weekend. Perhaps, the gender composition of children affects the behavioral changes in the household. Alternatively, girls might be less affected by whatever household behavior occurs on weekend receipt or girls might be better able to handle these behaviors.

Spillovers

We also consider the possibility that the timing of receipt by classmates might have impacts on performance. This might occur if recipients exhibit greater behavioral problems in the run-up to or during testing, which make reviews and the exam more difficult to administer. To study this we compute the share of recipients within a school that are receiving benefits in the previous weekend and the share that receive benefits more than 26 days before the exam. There are two sources of variation in each measure. First, some years the share of recipients that are treated varies (particularly for the share that receive benefits on the weekends); this will be true for all schools in those years. The second source of variation comes from differences across schools that are due to random differences in the distribution of case numbers of the students in that school. While the distribution of case numbers is uniform across South Carolina, within a school there is some variation. We then use "percent treated" measures as explanatory variables along with our individual receipt date dummies.

[Table 6]

Table 6 reports the results of this analysis. First, we note that the coefficients on the receipt date windows are largely unchanged by the inclusion of the spillover measures. Next, we see that coefficients on both the share of weekend recipients and the share that receive benefits more than 26 days prior to the exam are large and negative; however, neither is statistically significant (p-value of 0.108 for the share of weekend recipients). It is also worth noting that, due to the random allocation of case numbers, variation in the *share* of weekend receipt and the *share* of receipt more than 26 days prior to the exam is limited. For example, the 5th percentile for weekend share is 9%, while the 95th percentile is 28%. Thus, the point estimate from the models with fixed effects suggests that going from the 5th to the 95th percentile in treatment is associated with a three hundredths of a standard deviation reduction in test scores. Variation within student of the share across the school is also likely to be limited further. So, while the evidence is statistically weaker overall than the direct effects, the share estimates do suggest that some important spillovers may be present, and worth further inquiry.

Discussion and Conclusion

This project investigates the relationship between the date in which a household receives food stamps and the subsequent performance of students in those households on math scores. We exploit exogenous variation in the assignment of receipt dates for households as well as within student variation in receipt date over time.

Our main results imply that there is a statistically significant negative relationship between particularly long gaps between receipt and test date using within student variation. Further, we find that the receipt of benefits on the four days prior to the exam is also associated with significantly worse scores. While the magnitudes of these effects are small, they provide evidence that late in the benefit cycle and just after weekend receipt student cognitive abilities might be negatively impacted, and they only measure the impact of one such occurrence. Given that we believe that learning is a cumulative process, when we consider the number of days each month that are late in the benefit cycle and the number of months where there is a weekend receipt, then the effects could be much larger as each recipient student is subjected to several such occurrences each year.

The result that particularly long waits has an effect on test scores is consistent with results in the literature showing that households have a particularly hard time consumption smoothing. While, increasing the difference from nine to ten might have no effect, as the household's monthly resources are not yet exhausted, as the gap between receipt and test date nears a full month, households face greater food insecurity. This food insecurity appears to have negative effects on test performance. Given that we have no observations between 15 days and 26 days since receipt, we cannot say anything about precisely when this might become binding.

The mechanism behind the effect on receipt just prior to the exam is less obvious. It could represent a negative effect for individuals that did not receive benefits during the prior week, when perhaps reviews were undertaken. Or perhaps is related to mitigation efforts by schools that focus on the days closest to the exam. Another alternative is that weekend receipt date effects household consumption in ways that might affect performance. In particular, alcohol purchases in the household might be larger on weekend receipt dates. Given the finding in Castellari, et. al. (2016) that food stamp eligible households increase monthly beer purchases when food stamps are received on weekends, this seems like a plausible explanation.

Our results are consistent with a two-fold story: receipt timing affects hunger and receipt timing affects behavior. First, households are unable to effectively smooth consumption across the month, with household resources being exhausted at the end of the month. Second, they imply that households have a differential behavioral response associated with weekend receipt, possibly due to higher alcohol purchases. This provides further evidence that the timing of receipt changes household routines.

These results imply that policy makers should consider greater efforts to help ensure that households can effectively smooth consumption. In particular, we find evidence that in addition to a failure to smooth consumption, this is associated with negative impacts in an area of public concern. This might suggest that policy makers should split the benefit distribution into multiple days in a month or possibly they should use other interventions or adjustments in benefits to help smooth consumption. Our results also imply that there are potentially meaningful benefits to restricting benefit distribution to within the week. Although this could potentially increase food insecurity mildly in some months by making the days between receipt less consistent. Finally, while the focus of this analysis is on SNAP receipt, these results suggest that policy makers should consider how behavioral responses to receipt of benefits could have public health consequences in general.

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TABLES

Table 1: Descriptives

	Mean	Std
Math Score (normalized)	-0.35	1.04
Black	0.65	0.48
Female	0.50	0.50
Days since last receipt by math test date	8.23	7.68
Number of observations	1,061,303	

Notes: Days since is calculated as the number of days past since the last receipt day as of the date of Math Exam. Sameday receipts are considered as "30 days since".

Table 2: The Effect of Days Since Receipt on Test Scores

Days since receipt:	
1	-0.0113
	[0.0111]
2	-0.0192**
	[0.0097]
3	-0.0141*
	[0.0084]
4	-0.0127*
	[0.0073]
5	-0.0074
	[0.0062]
6	-0.0029
	[0.0052]
7	-0.0057
	[0.0043]
8	-0.0024
	[0.0036]
10	0.0037
	[0.0036]
11	0.0056
	[0.0048]
12	0.0068
	[0.0067]
13	0.0018
	[0.0097]
14	0.0055
	[0.0109]
27	-0.0459**
	[0.0179]
28	-0.0349**
	[0.0158]
29	-0.0242*
	[0.0138]
30	-0.0271**
	[0.0126]

Notes: This regression also includes grade-year and individual fixed effects. Clustered standard errors are in brackets. **,* denote statistical significance at the 0.05 and 0.1 level, respectively.

Table 3: The Effect of Receipt Window on Math Scores

Timing of SNAP Receipt:	[1]	[2]
Four Days Preceding Exam	-0.0051**	
	[0.0025]	
Week of Exam		-0.0063*
		[0.0034]
Weekend Before Exam		-0.0064**
		[0.0026]
More than 26 Days	-0.0139***	-0.0158***
	[0.0044]	[0.0048]
Number of Observations	1,061,303	1,061,303
Number of Individuals	372,063	372,063

Notes: All specifications include individual, school, and grade-year fixed effects. Clustered standard errors are in brackets. ***, **, * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 4: The Effect of a Randomly Assigned Receipt Date

Timing of SNAP	[1]	[2]	[3]
Four Days Preceding Exam		-0.0006	
		[0.0025]	
Week of Exam			0.0001
			[0.0033]
Weekend Before Exam			0.0001
			[0.0025]
More than 26 Days		-0.0017	-0.0009
		[0.004580]	[0.0047]
Days since receipt:			
1	-0.0008		
	[0.0085]		
2	-0.0035		
	[0.0066]		
3	-0.0029		
	[0.0049]		
4	0.0006		
	[0.0036]		
6	0.0011		
	[0.0035]		
7	-0.0021		
	[0.0050]		
8	-0.0007		
	[0.0067]		
9	0.0060		
	[0.0084]		
10	0.0031		
	[0.0100]		
11	0.0007		
	[0.0122]		
12	0.0016		
	[0.0145]		
13	-0.0130		
	[0.0175]		
14	-0.0110		
	[0.0194]		
27	-0.0187		
	[0.0170]		
28	-0.0154		
	[0.0146]		
29	-0.0054		
	[0.0123]		
30	-0.0017		
	[0.0107]		
Number of Observations	1,061,303	1,061,303	1,061,303
Number of Individuals	372,063	372,063	372,063

Notes: All specifications include individual, school, and grade-year fixed effects. Clustered standard errors are in brackets. No estimates are statistically significant the 0.10 or lower level.

Table 5: The Effect of Receipt Window by Sex and Race

	African American		Whites and Other Races	
Panel A	**Girls**	**Boys**	**Girls**	**Boys**
Four Days Preceding Exam	-0.0022	-0.0135***	-0.0003	-0.0004
	[0.0040]	[0.0048]	[0.0052]	[0.0059]
More than 26 Days	-0.0142**	-0.0234***	-0.0031	-0.0050
	[0.0069]	[0.0087]	[0.0094]	[0.0105]
Number of Observations	343,352	344,108	184,566	189,277
Number of Individuals	111,384	112,938	74,957	77,578
Panel B				
Week of Exam	-0.0050	-0.0073	-0.0098	-0.0047
	[0.0054]	[0.0067]	[0.0073]	[0.0083]
Weekend Before Exam	-0.0025	-0.0165***	0.0006	-0.0022
	[0.0041]	[0.0051]	[0.0053]	[0.0061]
More than 26 Days	-0.0167**	-0.0203**	-0.0103	-0.0093
	[0.0074]	[0.0094]	[0.0103]	[0.0116]
Number of Observations	343,352	344,108	184,566	189,277
Number of Individuals	111,384	112,938	74,957	77,578

Notes: All specifications include grade-year, school, and individual fixed effects. Clustered Standard errors are in brackets. *** and ** denote statistical significance at the 0.01 and 0.05 levels, respectively.

Table 6: The Effect of School Level Receipt Date on Performance

	[1]	[2]
Four Days Preceding Exam	-0.0051**	
	[0.0025]	
Week of Exam		-0.0063*
		[0.0034]
Weekend Before Exam		-0.0060**
		[0.0027]
More than 26 Days	-0.0139***	-0.0156***
	[0.0044]	[0.0048]
Share of School Weekend Receipt	-0.0022	-0.0282
	[0.0176]	[0.0176]
Share of School More than 26	-0.0036	-0.0095
	[0.0285]	[0.0262]
Number of Observations	1,061,303	1,061,303
Number of Individuals	372,063	372,063

Notes: All specifications include grade-year, school, and individual fixed effects. Clustered standard errors are in brackets. ***, **, * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

APPENDIX

Appendix Table 1: Comparison of our sample test scores to all scores for 2008

	All Students		Our Data	
Grade Level	Mean	Std	Mean	Std
3rd	308.7	15.3	308.7	15.4
4th	411.6	16.8	411.5	17.1
5th	510.7	16	510.5	16.2
6th	610.4	17.8	610.3	18.3
7th	710.5	15.2	710.6	16
8th	806	13	805.9	13.3
Number of Obsevations	310,596		231,998	

Note: Our data here includes both recipients and a subset of non-recipients.

Appendix Table 2: Distribution of Assigned SNAP Receipt Date

Last Digit/Receipt Date	Number of Observations	Share
1	106,131	0.100
2	107,484	0.101
3	106,165	0.100
4	107,377	0.101
5	105,131	0.099
6	105,722	0.100
7	107,166	0.101
8	105,071	0.099
9	105,634	0.100
0 (Distributed on the 10th)	105,422	0.099

Appendix Table 3: The Effect of Days Since Receipt on Test Scores

	[1]	[2]
Days Since Receipt	-0.00025**	-0.00024**
	[0.00011]	[0.00011]
School Fixed Effects	NO	YES
Number of Observations	1,061,303	1,061,303
Number of Individuals	372,063	372,063

Notes: All specifications include grade-year and school fixed effects. Clustered standard errors are in brackets. ** denote statistical significance at the 0.05 level.