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Abstract

National surveys follow consumers' expectations of future inflation, because they may directly affect the economic choices they make, indirectly affect macroeconomic outcomes, and be considered in monetary policy. Yet relatively little is known about how individuals form the inflation expectations they report on consumer surveys. Medians of reported inflation expectations tend to track official estimates of realized inflation, but show large disagreement between respondents, due to some expecting seemingly extreme inflation. We present two studies to examine whether individuals who consider specific price changes when forming their inflation expectations report more extreme and disagreeing inflation expectations due to focusing on specific extreme price changes. In Study 1, participants who were instructed to recall *any* price changes or to recall *the largest* price changes both thought of various items for which price changes were perceived to have been extreme. Moreover, they reported more extreme year-ahead inflation expectations and showed more disagreement than did a third group that had been asked to recall the *average* change in price changes. Study 2 asked participants to report their year-ahead inflation expectations, without first prompting them to recall specific price changes. Half of participants nevertheless thought of specific prices when generating their inflation expectations. Those who thought of specific prices reported more extreme and more disagreeing inflation expectations, because they were biased toward various items associated with more extreme perceived price changes. Our findings provide new insights into expectation formation processes and have implications for the design of survey-based measures of inflation.

Key words: inflation expectations, perceptions of specific prices, memory bias, recall

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1. Introduction

Many of the economic decisions that consumers face have effects that extend well into the future. Individuals' expectations of inflation should play a central role in these decisions, thus affecting economy-wide outcomes (Katona, 1975). As a result, consumer inflation expectations are central to macro-economic models and monetary policy (Gali, 2008), with national surveys of public inflation expectations being conducted in multiple countries (Blanchflower & Coile, 2009; Bryan & Venkatu, 2001; Curtin, 1996; Jonung, 1981; Ranyard, Del Missier, Bonini, Duxbury, & Summers, 2008). The Reuters/University of Michigan Survey of Consumers (henceforth, Michigan Survey) has been measuring Americans' inflation expectations for more than 50 years (Curtin, 1996, 2006). Median responses generally track official estimates of realized inflation, sometimes even outperforming professional forecasters (Hafer & Hein, 1985; Thomas, 1999; Ang, Bekaert & Wei, 2007).

However, these survey measures of inflation expectations also tend to show considerable disagreement between respondents, with some reporting seemingly extreme inflation expectations (Bruine de Bruin, van der Klaauw, Downs, Fischhoff, Topa, & Armantier, 2010; Bryan & Venkatu, 2001; Curtin, 2006). Because price changes are not uniform across product categories, variations in individuals' consumption patterns may partially explain the observed variations in their inflation expectations (Bryan & Venkatu, 2001; McGranahan & Paulson, 2006; Ranyard et al., 2008). However, Hobijn et al. (2009) suggest that individual differences in experienced inflation are actually relatively small, noting that between 1995 and 2005 annual inflation rates experienced varied by only .2-.4% across different demographic groups (see also Kokoski, 2000).

Another possible source of disagreement in inflation expectations may be that respondents vary in their interpretation of the survey questions that ask for their inflation expectations. To avoid the term “inflation,” most existing inflation expectations questions, such as those posed on the Michigan Survey, ask for expected changes in “prices in general.” While some respondents recognize that wording as asking about the U.S. inflation rate, others interpret it as asking about their personal expenses and the prices they pay – with the latter interpretations being related to reporting more extreme inflation expectations (Bruine de Bruin et al., 2010). Moreover, compared to questions asking about “prices in general,” alternative questions that directly ask about “inflation” tend to elicit less extreme and less dispersed expectations, thus suggesting less disagreement between respondents.

Here, we examine why individuals who think of specific prices report higher inflation expectations. We hypothesize that, when individuals base their inflation expectations on prices they pay, more extreme price changes will come to mind. Memory research has found that, when making predictions about the future (e.g., how much they will enjoy a sports game, how long a train ride will take, etc.), people tend to incorporate their past experiences – with the more extreme ones being more likely to come to mind (Morewedge, Gilbert, & Wilson, 2005). If so, individuals who think of specific price changes to form their inflation expectations will be disproportionately focusing on items for which they experienced extreme price changes, even if these changes were only temporary, and even if these items have a low expenditure weight in official estimates of inflation.

While extreme experiences are more likely to be remembered, memory for specific events also tends to become stronger with increased exposure. Psychological theories of perceived inflation have therefore proposed that extreme price changes should be especially

salient for goods that are purchased frequently, such as food and gas (Antonides, 2008; Bates & Gabor, 1986; Brachinger, 2008; Fluch & Stix, 2005; Jungermann et al., 2007; Ranyard et al., 2008). In periods of moderate to high inflation, large price increases will be more common than large price decreases, and be noticed especially by individuals who are concerned that prices might be increasing (Bruine de Bruin et al., 2010; Greitemeier, Schulz-Hardt, Traut-Mattausch, & Frey, 2005). Perhaps as a result, suspicious European consumers perceived increased inflation after the introduction of the Euro in 2002, despite official estimates showing that realized inflation actually remained virtually unchanged (for a review, see Ranyard et al., 2008). Naturally, even if individuals focus on the same product categories, they may remember different instances in which prices changed. If so, focusing on specific price changes when forming overall inflation expectations should lead to more extreme inflation expectations, as well as more disagreement between respondents, as seen in a more dispersed distribution of their inflation expectations.

Here, we present two studies to directly examine whether individuals who consider specific price changes when forming their inflation expectations may unintentionally focus on extreme price changes they have noticed, thus affecting the extremeness of their reported inflation expectations, and overall disagreement between respondents. In the first study, we randomly assigned participants to instructions to report (1) *any price change* they had noticed over the past 12 months, (2) *the largest price change* they had noticed over the past 12 months, or (3) *the average change in prices* over the past 12 months. We predicted that the groups recalling *any* price changes or the *largest* price changes would remember similarly large price changes, due to memory being biased towards extreme instances. Both groups should report higher inflation expectations than the third group that was instructed to recall the *average* change

in prices. Because of individual differences in the specific price changes individuals may have noticed, we also predicted that the groups recalling any price change or the largest price change would show more dispersed perceptions of specific past-year price changes, resulting in more disagreement in their reported inflation expectations.

In the second study, we asked people to report their expectations of inflation for the year ahead, without first being prompted to focus on specific price changes. Subsequently, participants were asked whether they thought of a specific price when generating their inflation expectations. We predicted that those who thought of a specific price would report more extreme inflation expectations than those who did not think of a specific price, because of focusing on items with more extreme price changes, as well as more dispersed inflation expectations, due to individual differences in that specific focus.

2. Study 1

2.1. Material and methods

2.1.1. Participants. A total of 300 participants were recruited through Amazon's Mturk. Eighteen were excluded from the analyses because they failed to provide correct answers to six simple screening questions (e.g., what is the smallest number in this set with options 1, 400, and 7000), suggesting that they did not pay attention to answering the survey. Of the remaining 282 participants, 64.5% were female, and 44.7% had no college degree. Ages ranged from 18 to 81 ($M=33.8$, $SD=12.3$). Median income was in the \$40,000-\$60,000 category. Of those reporting race, 27.0% were non-white.

2.1.2. Procedure. Participants responded to an ad on Amazon's Mturk to participate in an online survey about financial decisions. They were offered \$.50, which is above the norm at

Mturk. The survey was online between August 18 and September 19 of 2010. Participants were randomly assigned to one of three recall instructions. Before being asked to report their inflation expectations for the year ahead, they were first asked to “please think of” (1) “*any* price change you have noticed over the past 12 months,” (2) “*the largest* price change you have noticed over the past 12 months,” or (3) “*the average* change in prices you have noticed over the past 12 months.” Those receiving the first two recall instructions filled in a blank with the specific good or service they thought of. Subsequently, they reported their perception of past-year changes in that price, by answering “over the past 12 months, did this price go up, go down, and stay the same?” with those who answered “it went up” or “it went down” also answering “by about what percent did this price go [up/down] over the past 12 months?” The third group received a similar question that asked for their perception of the average change in prices over the past 12 months, without first being prompted to recall specific price changes.

Next, all participants reported their year-ahead inflation expectations using the Michigan Survey’s “prices in general” question (Curtin, 1996). That is, participants were first asked “during the next 12 months, do you think that prices in general will go up, or go down, or stay where they are now?” Those who answered that prices would go up indicated whether they meant that prices “will go up at the same rate” or “will not go up.” Participants who indicated that they expected prices in general to go up or down were asked “by about what percent do you expect prices to go [up/down] on the average, during the next 12 months?” Following Michigan procedures, participants who reported extreme inflation expectations over 5% or below -5% were encouraged to rethink their answer with the follow-up question “Let me make sure I have that correct. You said that you expect prices to go up during the next 12 months by [x%]. Is that

correct?” At the end of the survey, all participants reported demographic information, including their age, gender, education, income, and racial background.

2.2. Results.

2.2.1. Extremeness and dispersion of recalled price changes. Table 1 shows two measures of extremeness. Because participants may have recalled large price increases, we examined extremeness by computing the absolute deviation of the recalled price change from 0%. It showed a near-perfect correlation ($r_s=.99, p<.001$) with the absolute deviation from the Consumer Price Index (CPI) for urban Americans, which was 1.1% for the 12 months preceding the launch of the survey in August 2010 (Bureau of Labor Statistics, 2010). Hence, both measures yield similar results. We also examined extremeness by computing the percent of responses above 5% and below -5%. We chose 5% and -5% as thresholds for extremity, because the CPI has not been outside of that range since 1990 (Bryan & Venkatu, 2001), and because the Michigan Survey treats responses outside that range as suspect, following them up with a question encouraging respondents to reconsider their answer (Curtin, 1996).

As expected, Table 1 shows that participants who were asked to recall any price change they had noticed over the past 12 months reported more extreme price changes than those who were asked to recall the average change in prices over that same period, as seen in the larger absolute deviation of their responses from zero percent change. The Mann-Whitney (M-W) test, a non-parametric equivalent of the t-test (Siegel & Castellan, 1988), showed that this group difference was indeed significant (M-W $z=-8.21, p<.001$). Similarly, chi-square tests showed that, compared to participants who were instructed to recall the average price change, those who recalled any price change were significantly more likely to report perceived price increases over

5% ($\chi(1)=57.20, p<.001$), but not more likely to report perceived price decreases below -5% -- which they did not report at all ($\chi(1)=1.78, p=.18$). Because participants who were asked to recall any price change focused more on extreme increasing prices than on extreme decreasing prices, the past-year price changes they reported were significantly larger than those of participants recalling average price changes (M-W $z=-8.40, p<.001$).

Memory appeared biased towards extreme price changes, with participants who were asked to recall any price change reporting price changes that were only marginally less extreme than participants recalling the largest price change (M-W $z=1.87, p=.06$). Specifically, they were more likely to recall price increases over 5% ($\chi(1)=8.76, p<.001$) and less likely to recall price decreases below -5% ($\chi(1)=20.00, p<.001$). Perhaps as a result, their inflation expectations were marginally larger (M-W $z=1.66, p=.09$). Hence, these findings suggest that, when recalling any price change, the largest increasing prices were especially likely to come to mind.

Moreover, compared to participants recalling any price change, those recalling the largest price change differed in the same ways from those recalling the average change in prices. That is, their responses showed a larger deviation from zero (M-W $z=-8.21, p<.001$), were more likely to be over 5% ($\chi(1)=23.45, p<.001$), and below -5% ($\chi(1)=16.67, p<.001$), showed larger absolute deviation from their group median (M-W $z=-7.44, p<.001$), and were significantly higher (M-W $z=-3.42, p<.001$).

Table 2 shows the specific items participants reported thinking of, if they were asked to recall any or the largest past price changes. Those recalling any price change and those recalling the largest price change thought of similar items, $\chi(7)=11.54, p=.12$. Across participants recalling any price change and participants recalling the largest price change, gas and food were most likely to come to mind, with some participants thinking about housing. For both groups,

median past-year perceptions of price changes for the specific products were much higher than official past-year CPI estimates for gas and transportation (4.9%), food and beverages (1.0%), housing (-.4%), clothing (-.4%), education (1.9%), health care (3.2%), recreation (-1.1%) reported for the month the survey went online (Bureau of Labor Statistics, 2010). However, median perceptions reported by any-price recallers were significantly higher than those reported by largest-price recallers, for housing (M-W $z=-2.36$, $p=.02$) and recreation (M-W $z=-2.63$, $p<.01$), likely because any-price recallers did not think of extreme price decreases (below -5%) at all. Overall, these results suggest that, when remembering past price changes, items that are perceived to have shown extreme price increases are most likely to come to mind.

2.2.2. Extremeness and dispersion of inflation expectations. Table 3 shows the year-ahead inflation expectations that were reported by participants in each recall condition. Across participants, reported inflation expectations were positively correlated to recalled price changes ($r_s=.38$, $p<.001$). However, participants who had been instructed to recall a specific price change may have realized that their memories were biased towards extreme price increases, because they adjusted their inflation expectations to be lower than recalled price changes (Wilcoxon $z=-6.95$, $p<.001$), using fewer responses over 5% (Wilcoxon $z=-6.03$, $p<.001$) or below -5% (Wilcoxon $z=-2.83$, $p<.001$), and showing less disagreement in terms of absolute deviation from the median (Wilcoxon $z=-5.29$, $p<.001$). Similarly, those who had recalled the largest price change also adjusted their inflation expectations downwards, compared to the recalled price change (Wilcoxon $z=-6.95$, $p<.001$), being less likely to use responses over 5% (Wilcoxon $z=-6.03$, $p<.001$) or below -5% (Wilcoxon $z=-2.83$, $p<.01$), while showing reduced disagreement in terms of absolute deviation from the median (Wilcoxon $z=-2.69$, $p<.01$). By comparison, inflation expectations were no different from recalled average price changes for participants who had

recalled the average change in prices, in terms of their median, or percent of responses above 5% or below -5% (all $p > .10$), except that they did show less absolute deviation from the median (Wilcoxon $z = -2.07$, $p = .04$).

Table 3 also shows the extremeness of reported inflation expectations, reflected in the absolute deviation from the Federal Reserve's implicit inflation target and the European Central Bank's explicit targeted inflation ceiling of 2%, as well as (as above) the percent of responses above 5% and below -5%. Disagreement between respondents is reflected in the absolute deviation from the median in their recall instruction group (i.e., recalling any, the largest, or the average price) as our measure of dispersion, which is more reliable than the standard deviation in skewed distributions (Conover, Johnson, & Johnson, 1981) commonly observed with price perceptions and expectations (Bruine de Bruin, van der Klaauw, Downs, Fischhoff, Topa, & Armantier, 2010; Bryan & Venkatu, 2001; Curtin, 2006).

As expected, group differences in reported inflation expectations were in the same direction as group differences in reported past price changes. Participants who had recalled any price change reported more extreme inflation expectations than those who had recalled the average change in prices, with their responses showing larger deviation from 2% (M-W $z = -4.90$, $p < .001$), being marginally more likely to be over 5% ($\chi(1) = 3.35$, $p = .06$), and significantly more likely to be below -5% ($\chi(1) = 6.69$, $p < .01$). They also showed more disagreement, as seen in their responses deviating more from their group median (M-W $z = -3.89$, $p < .001$). Although the median of their reported inflation expectations was somewhat larger, that difference was not significant (M-W $z = -.92$, $p = .36$).

Participants who were asked to recall any price change showed no differences in inflation expectations from those who recalled the largest price change (all $p > .10$). Moreover, compared

to participants recalling any price change, those recalling the largest past-year price change generally differed in the same ways from those recalling the average change in prices. That is, their inflation expectations were more extreme, as seen in a larger absolute deviation from 2% (M-W $z=-4.88$, $p<.001$), more responses over 5% ($\chi(1)=5.29$, $p=.02$), and more responses below -5% ($\chi(1)=4.40$, $p=.04$), and more dispersion, as seen in larger absolute deviation from their group median (M-W $z=-4.93$, $p<.001$). Overall, they also had significantly higher medians (M-W $z=-3.33$, $p<.001$).

2.2.3. Linear regressions predicting extremeness and dispersion of inflation expectations.

Table 4 shows a linear regression predicting extremeness of inflation expectations for the next 12 months, using the log-transformed absolute deviation of inflation expectations from the Federal Reserve's implicit targeted inflation ceiling of 2% as the dependent variable (after adding 1 to all observations to avoid undefined values for values of 0). Model 1 uses recall instructions as predictor variables, while controlling for demographic variables. As reported above, participants who had received instructions to recall any price change (vs. not) or the largest price change (vs. not) reported significantly higher inflation expectations than those who were asked to recall average price changes, even when controlling for demographic variables. Model 2 adds the log-transformed absolute recalled price change (after adding 1) as a predictor, showing that it is significantly related to the extremeness of inflation expectations, while rendering the effect of instructions to recall any price or the largest price non-significant, suggesting significant mediation. Model 3 suggests that remembering large price increases (over 5%) especially contributed to reporting more extreme inflation expectations, with remembering large price decreases (below -5%) also contributing. Table 4 shows the same pattern in a logistic regression predicting extremeness of inflation expectations as reflected in whether or not responses were

above 5% or below -5%, and in a linear regression predicting the dispersion of inflation expectations reflected in the absolute deviation from the median of the participants' group (i.e., instructed to recall any, the largest, or the average change in prices.) Hence, these results suggest that participants who were instructed to recall price changes reported more extreme and more dispersed inflation expectations because of more extreme price changes, and especially increases, being more likely to come to mind.

2.3. Discussion

Our results suggest that, as predicted, memories of the past year's changes in prices are biased towards those goods and services that have shown the largest price changes, affecting the extremeness and dispersion of subsequently reported inflation expectations. Participants who were asked to report any price changes they had noticed over the past year thought of price changes that were almost as extreme as those reported by participants who were asked to report the largest price changes they had noticed. Indeed, both of these groups reported price changes that were significantly larger than the average price change reported by a third group. Most of the participants who were instructed to recall (any or the largest) specific price changes thought of gas and food, likely because these items showed larger overall past-year price changes (Bureau of Labor Statistics, 2010) which that may have been especially salient due to repeated purchases (Antonides, 2008; Bates & Gabor, 1986; Brachinger, 2008; Fluch & Stix, 2005; Jungermann et al., 2007; Ranyard et al., 2008). Some participants also thought about housing, which had not been showing large overall inflation (Bureau of Labor Statistics, 2010) but may have shown regional variation and had been receiving media attention at the time (e.g., Streitfeld, 2010). Compared to participants who were only instructed to recall average price changes, those

who were instructed to recall specific price changes reported larger price changes. Recalled changes for specific items were also larger than official inflation estimates for these items (Bureau of Labor Statistics, 2010), likely because specific instances of large price changes came to mind more easily. Disagreement in the specific price changes participants reported was relatively large, possibly due to individuals recalling different personal experiences with these prices.

Having been asked to recall specific price changes that had occurred over the past year affected expectations for next-year expectations of inflation, such that participants who had recalled any price change or the largest price change reported more extreme and more dispersed inflation expectations than those who had recalled the average change in prices they had noticed over the past year. These group differences were mediated by the extremeness of the price changes, and especially extreme increases, that were recalled.

Naturally, we recognize that our instructions to recall prices may have created experimental demand, artificially suggesting to participants that memories for past-year prices should be taken into account when subsequently reporting inflation expectations. However, participants may have recognized that the past experiences they remembered were too extreme to inform their overall inflation expectations (Morewedge et al., 2005). Indeed, participants who had recalled any or the largest price changes adjusted their inflation expectations to be less extreme than the prices they had recalled. Participants may have unintentionally anchored on their initial memories for specific price changes, insufficiently adjusting their inflation expectations to be less extreme (Tversky & Kahneman, 1974). Perhaps as a result, the extremeness of their inflation expectations was related to the extremeness of the prices they had recalled.

Another limitation of Study 1 is that it provides no insights into whether or not participants who were instructed to recall the average change in prices tried to remember specific changes in prices. If, as we expect, memory is biased towards extreme instances, then those who tried to recall specific price changes when assessing average price changes should have reported perceptions more reflective of the more extreme price changes. The remaining participants may have instead been trying to assess what overall inflation indicators had been (Bruine de Bruin et al., 2010). Alternatively, it might be the case that instructions to recall the average change in prices that has occurred over the past year does evoke memories of specific price changes, but focuses participants on those that are more representative of overall inflation, and therefore less extreme.

Study 2 aimed to alleviate concerns about experimental demands, and to examine which specific prices participants may think of when reporting expectations for inflation. Participants were therefore asked to report their inflation expectations without first receiving instructions to recall past-year changes in specific prices. That is, the survey began by asking for next-year inflation expectations. Subsequently, participants were asked whether they had thought of specific prices when generating their inflation expectations, and, if so, what kind. We predicted that participants who thought of specific prices would report more extreme and more dispersed inflation expectations, due to biased attention towards extreme price changes.

3. Study 2

3.1. Materials and methods.

3.1.1. Participants. A total of 97 participants were recruited through Amazon's Mturk to participate in an online survey about "financial decisions." Five were excluded from the

analyses because they failed to provide correct answers to six simple screening questions (e.g., what is the smallest number in this set with options with options 1, 400, and 7000), suggesting that they did not take care in answering the survey. Of the remaining 92 participants, 72.0% were female, and 45.2% had no college degree. Ages ranged from 18 to 67 ($M=32.7$, $SD=11.4$). Median income was in the \$40,000-\$60,000 category. Of those who reported race, 17.4% were non-white.

3.1.2. Procedure. Participants responded to an ad on Amazon's Mturk to participate in an online survey about "financial decisions." They were offered \$.50, above the norm at Mturk. The survey was online between August 18 and September 19 of 2010. To avoid having the same participants in the two studies, participants to Studies 1 and 2 were recruited at the same time, with random assignment to Study 1 or to Study 2 conditions.

Participants reported their year-ahead inflation expectations using Michigan's "prices in general" question (Curtin, 1996), following the same procedure outlined for Study 1. Subsequently, they were asked "When answering the question about 'prices in general during the next 12 months' were you thinking of prices for any specific things?" Those who said "yes" were then asked to select what they had thought about the most, from a list including (a) Food, which includes groceries, dining out, and beverages, (b) Gas and transportation, which includes gasoline, public transportation fares, and car maintenance, (c) Housing, which includes mortgage or rent, maintenance and utilities, (d) Stocks and bonds, (e) Clothing, (f) Health care, (g) Income taxes, (h) Recreation and entertainment, (i) Education and child care, and (j) I thought of another specific price, followed by a prompt to type their answer into a textbox. This question was repeated for those who indicated having thought of a second price. Those who had thought of specific goods were then asked for their year-ahead inflation expectations for those goods,

adapting the question that asked for their year-ahead expectations for “prices in general” (Curtin, 1996). All participants were asked to report their year-ahead price expectations for gas, food, and housing, which were the three product categories that were most likely to come to mind in Study 1. At the end of the survey, participants reported demographic information such as age, gender, income, education, and racial background.

3.2. Results.

3.2.1. Extremeness and dispersion of inflation expectations. Approximately half of participants reported spontaneously thinking of at least one specific price when generating their inflation expectations (52.2%). Table 5 reports on the extremeness, dispersion and the central tendency of reported inflation expectations. As expected, Mann-Whitney tests showed that thinking about a specific price was related to reporting more extreme inflation expectations, as seen in their absolute deviation from the Federal Reserve’s implicit inflation target ceiling of 2% (M-W $z=-2.03$, $p=.04$), showing more disagreement, in terms of the absolute deviation from the group median (M-W $z=-2.70$, $p<.01$), with chi-square tests showing that they were marginally more likely to report inflation expectations above 5% ($\chi(1)=2.84$, $p=.09$), but not being more likely to report inflation expectations below -5% ($\chi(1)=.31$, $p=.58$). Although thinking about a specific price was related to reporting more extreme and more dispersed inflation expectations, it was not related to these expectations being different in terms of overall central tendency (M-W $z=-.98$, $p=.32$).

A total of 29.3% also reported also thinking of a second price. Likely because the first price that comes to mind is the most important, and because few participants thought of a second price, thinking of a second price was not related to reported inflation expectations in terms of their absolute deviation from 2%, the percent above 5% or below 5%, their absolute deviation

from the group median, or their overall size (all $p > .10$). Hence, subsequent analyses only report on the first price change respondents thought of.

3.2.2. Expectations for specific prices. Table 6 shows the specific items participants reported thinking of, when generating their inflation expectations. As expected, those who thought of a specific price were most likely to report thinking of prices for food or gas, with only a few thinking about housing or clothing. Respondents who reported thinking of gas or food gave more extreme expectations for that price, as seen in absolute deviations from 2%, than those who did not report thinking of that price (M-W $z = -2.49$, $p = .01$ for gas; M-W $z = -2.06$, $p = .04$ for food). By contrast, they did not have more extreme expectations for other prices ($p > .10$). Percent of responses above 5% and below -5% showed a similar pattern. Respondents who reported thinking of housing did not report more extreme expectations for housing or other prices (all $p > .10$).

Perhaps more importantly, respondents who thought of a specific price also seemed more likely to use their expectation for that price to inform their inflation expectations compared to those who did not think about that price, as seen in having higher correlations between their expectation for the specific price and the inflation expectations ($r_s = .60$, $p < .000$ vs. $r_s = .44$, $p < .000$ for food, $z = -1.54$, $p = .12$; $r_s = .87$, $p < .000$ vs. $r_s = .50$, $p < .000$ for gas; $r_s = .65$, $p < .01$ vs. $r_s = .19$, $p < .001$ for housing), as seen in combined tests for comparing the difference between Fisher z -transformed correlations ($z = 5.02$, $p < .001$) (Rosenthal & Rosnow, 1991).

3.2.3. Linear regressions predicting dispersion in inflation expectations. Table 7 shows the results of two separate sets of linear regression models for predicting the extremeness of inflation expectations, reflected in log-transformed absolute deviation of inflation expectations from the Federal Reserve's implicit targeted inflation ceiling of 2%, as well as the disagreement

of inflation expectations, reflected in log-transformed absolute deviation from the group median. Model 1 shows that participants who thought of specific prices reported inflation expectations that differed more from the central bank target ceiling and from their group median, even after controlling for demographic variables. Model 2 shows that both the extremeness and dispersion of inflation expectations were significantly related to the log-transformed extremeness of expectations for gas, food, and housing prices, while adding these variables somewhat reduced the role of whether or not participants thought about specific prices.

Models 3 and 4 were similar to models 1 and 2, but replaced whether or not participants thought of specific prices with whether or not they thought of gas, food or housing. Because most of the participants who thought of specific prices thought of the prices for food, gas, or housing, adding all of these variables in one linear regression model led to problems with multicollinearity. Model 3 shows that thinking specifically of gas and housing prices was related to reporting more extreme inflation expectations that differed more from 2% and the group median. Model 4 shows that, when adding the extremeness of expectations for gas, food, and housing prices improved the predictions of extremeness and disagreement in inflation expectations, while whether or not participants thought about gas or housing prices still played at least a marginal role.

Model 5 adds interaction terms for gas, food, and housing prices, reflecting, for each whether or not participants thought of that specific price, and the extremeness of their expectations for that specific price. Participants who thought of a price when generating their inflation expectations reported more extreme inflation expectations that were more strongly related to their expectations for that specific price – whether it was gas, food or housing. The regression predicting disagreement in reported inflation expectations, in terms of absolute

deviation from the group median, shows a similar pattern, though only the interaction term for housing reaches significance ($p < .05$).

Logistic regressions were used to predict whether or not inflation expectations were outside the -5% to 5% range, using the same predictors as in Table 7. Model 1 did not show a significant relationship with whether or not participants thought of a specific price (OR=2.30, 95% CI=.77-6.89, $p = .14$). As in Table 7, Model 3 did show at least a marginally significant relationship with thinking about gas (OR=4.64, 95% CI=.97-22.22, $p = .06$), and housing (OR=9.28, 95% CI=1.38, 62.61), with Model 4 showing significant contributions for log-transformed extremeness of specific price expectations in terms of absolute deviation from 2%, for gas (OR=3.52, 95% CI=1.03-12.07, $p < .05$), and food (OR=11.88, 95% CI=2.26-62.56, $p < .01$) with a marginal contribution of housing (OR=3.01, 95% CI=.91-9.95, $p = .07$) but Model 5 showing no significant interactions likely due to insufficient variation in the dichotomous dependent variable ($p > .10$).

3.3. Discussion

Our results suggest that, when generating their expectations for inflation, some individuals may think about specific prices, while others do not. When individuals think about specific prices, those that are associated with more extreme perceived and expected changes are more likely to come to mind, resulting in more extreme inflation expectations. In Study 1, memories of the past year's price changes were most likely to focus on food and gas, with remembered price changes for these items being more extreme than the average perceived price change, as well as official CPI estimates for these product categories over the past year. Naturally, which extreme price changes come to mind may depend on the actual price changes that individuals have noticed during the previous year. Across individuals and over time, gas

and food may be especially salient, because they tend to show many large changes over short periods of time, and because they are purchased relatively often (Antonides, 2008; Bates & Gabor, 1986; Brachinger, 2008; Fluch & Stix, 2005; Jungermann et al., 2007; Kahneman & Tversky, 1979; Ranyard et al., 2008). Nevertheless, thinking about whatever price changes tend to be large at the time will bias inflation expectations to be more extreme.

4. Conclusions

Although survey measures of inflation expectations tend to track official inflation estimates, closer inspection of response distributions tends to show considerable disagreement between respondents, with some reporting relatively extreme inflation expectations (Bruine de Bruin et al., 2010; Bryan & Venkatu, 2001; Curtin, 2006). Our results suggest that that disagreement stems in part from whether or not individuals think about specific prices when generating their inflation expectations. In Study 1, we found that participants who were instructed to recall any price changes tended to remember goods and services for which they had noticed extreme price increases or extreme price decreases, and subsequently reported more extreme and more dispersed inflation expectations. In Study 2, we found that some participants thought of specific prices even when they were not prompted to do so, when forming their inflation expectations. Thinking about specific prices led to more extreme inflation expectations, because items associated with more extreme price expectations were more likely to come to mind. These findings are in line with research on memory and attention biases, which suggests that extreme instances are more vivid and therefore more likely to come to mind than less extreme ones (Morewedge et al., 2005).

Our studies were conducted in August and September of 2010, which was a period in which actual inflation was low. However, even when overall inflation is near-zero, price changes may vary across product categories (McGranahan & Paulson, 2006; Ranyard et al., 2008). Our participants were therefore able to notice and anticipate extreme changes in specific prices, biasing their inflation expectations. Some noticed and anticipated extreme price increases, while others noticed price decreases, thus leading to large absolute difference from zero, but not affecting median inflation expectations. As noted above, which price changes come to mind may depend on when inflation expectations are generated. During periods of relatively higher actual inflation, decreases in specific prices should be much less common, and increases in specific prices should be more extreme. Hence, biased attention towards extreme price changes should then be more likely to elicit expectations for extreme inflation rather than extreme deflation. Indeed, survey measures of inflation expectations have tended to show a tendency towards overestimation when actual inflation is relatively high (Bryan & Venkatu, 2001), especially among respondents who interpret inflation questions as asking about their personal expenses or prices they pay instead of the official U.S. inflation rate (Bruine de Bruin et al., 2010).

Participants who did not think about specific prices reported less extreme and less dispersed inflation expectations. Although we did not ask them to report how they generated their inflation expectations, previous research suggests that they probably thought of general indicators for overall inflation instead of examples for specific prices (Bruine de Bruin et al., 2010). Perhaps because they evoke less thinking about specific prices, survey questions that directly participants for their expectations for “the rate of inflation” tend to elicit less extreme

inflation expectations than traditional survey questions asking about “prices in general” (Bruine de Bruin et al., in preparation).

Even though individuals tend to show large disagreement in their expectations for inflation due to some reporting seemingly extreme expectations, their medians often outperform professional forecasters in terms of tracking actual inflation (Hafer & Hein, 1985; Thomas, 1999; Ang, Bekaert & Wei, 2007). A better understanding of how people form their inflation expectations may help to further improve survey measures of inflation expectations, as well as policy decisions that aim to incorporate or affect them.

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6. References

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Table 1: Perceptions of past-year price changes reported by participants receiving different recall instructions (Study 1).

Recall instructions	N	Extremeness			Central tendency	
		Median absolute deviation from 0%	Percent > 5%	Percent < -5%	Median	Mean (SD)
Any price change	90	14.00 ^m	81.1% ^{ml}	0.0%	14.00 ^m	16.92 (13.94) ^m
The largest price change	90	20.00 ^m	61.1% ^m	20.0% ^{mn}	10.00 ^m	12.32 (33.88) ^m
The average change in prices	102	3.25	26.5%	2.0%	3.00	4.35 (5.86)

Note: Mann-Whitney tests were used to test for group differences in medians; Chi-square tests were used to test for group differences in percent of participants.

^a= Median absolute deviation from the median observed for that group

^m= Significantly larger than for participants recalling “the average change in prices” (two-sided test; $p < .05$)

^l= Significantly larger than for participants recalling “the largest price change” (two-sided test; $p < .05$)

ⁿ= Significantly larger than for participants recalling “any price change” (two-sided test $p < .05$)

Table 2: Specific items reported by participants receiving different recall instructions (Study 1).

Item	Percent of participants		Median past-year perception		Median absolute past-year perception		Percent >5% ^a		Percent <-5% ^a	
	Any price change	The largest price change	Any price change	The largest price change	Any price change	The largest price change	The largest price change	The largest price change	Any price change	The largest price change
	Gas (including transportation)	41.1%	27.8%	10.0	10.0	10.0	10.0	100.0%	60.0%	.0%
Food (including beverages)	35.6%	32.2%	20.0	20.0	20.0	25.0	100.0%	82.8%	.0%	6.9%
Housing (including utilities)	4.4%	12.2%	25.0 ¹	-5.0	25.0	15.0	100.0%	36.4%	.0%	63.6%
Clothing	.0%	2.2%	-	-27.5	-	37.5	-	50.0%	-	50.0%
Education	1.1%	1.1%	20.0	5.0	20.0	5.0	100.0%	.0%	.0%	.0%
Health care	.0%	1.1%	-	10.0	-	10.0	-	100.0%	-	.0%
Recreation	11.1%	8.9%	25.0 ¹	-20.0	25.0	23.5	80.0%	25.0	.0%	75.0%
Other	6.7%	14.4%	10.0	20.0	10.0	20.0	66.7%	61.5%	.0%	7.7%

Note: Participants filled in a blank, noting the good or service they thought of. A chi-square test showed that the response pattern was not significantly different across conditions, $\chi(7)=11.54, p=.12$. Mann-Whitney tests were used to test for differences between reported medians in each condition.

^a =Among those who thought of the item.

¹ =significantly larger than for participants recalling “the largest price change” (two-sided test; $p<.05$)

Table 3: Inflation expectations reported by participants receiving different recall instructions (Study 1).

Recall instructions	N	Extremeness and dispersion			Central tendency		
		Median absolute deviation from 2%	Percent > 5%	Percent < -5%	Median absolute deviation from median ^a	Median	Mean (SD)
Any price change	90	3.50 ^m	36.7%	8.9% ^m	5.00 ^m	5.00	4.24 (10.09)
The largest price change	90	5.50 ^m	40.0% ^m	6.7% ^m	5.00 ^m	5.00	7.11 (16.23)
The average change in prices	102	2.00	24.5%	1.0%	3.00	3.00	3.69 (5.29)

Note: Mann-Whitney tests were used to test for group differences in medians; Chi-square tests were used to test for group differences in percent of participants.

^a= Median absolute deviation from the median observed for that group

^m= Significantly larger than for participants recalling “the average change in prices” (two-sided test; $p < .05$)

Table 4: Regression models predicting extremeness and dispersion of reported inflation expectations (Study 1).

Dependent variable	Linear regression predicting log-transformed absolute deviation from 2% (β)			Logistic regression predicting >5% or <-5% vs. not (OR, 95% CI)			Linear regression predicting log-transformed absolute deviation from median (β)		
	Model 1 ($R^2=.11$)	Model 2 ($R^2=.27$)	Model 3 ($R^2=.28$)	Model 1 ($R^2=.06$)	Model 2 ($R^2=.31$)	Model 3 ($R^2=.34$)	Model 1 ($R^2=.08$)	Model 2 ($R^2=.15$)	Model 3 ($R^2=.18$)
Instructed to recall any price change	.34 ^{***}	.04	.04	2.30 ^{**} (1.23, 4.27)	.55 ⁺ (.25, 1.20)	.78 (.37, 1.64)	.20 ^{**}	.04	.03
Instructed to recall largest price change	.30 ^{***}	.04	.13	2.52 ^{**} (1.36, 4.67)	.47 (.20, 1.09)	1.25 (.59, 2.65)	.29 ^{***}	.09	.10
Log-transformed extremeness of recalled price change	-	.50 ^{***}	-	-	3.75 ^{***} (2.48, 5.67)	-	-	.33 ^{***}	-
Recalled price change >5%	-	-	.50 ^{***}	-	-	21.0 ^{***} (8.63, 51.14)	-	-	.36 ^{***}
Recalled price change <-5%	-	-	.15 [*]	-	-	6.05 (1.67, 21.85)	-	-	.23 ^{**}

*** $p < .001$, ** $p < .01$, * $p < .05$, + $p < .10$

Note: All models included demographic controls for age, gender, income being below the median, having no college degree, and being non-white. Results were similar without controls.

Table 5: Reported inflation expectations by whether or not participants spontaneously thought of a specific price (Study 2).

Recall instructions	Percent of respondents	Extremeness and dispersion			Central tendency		
		Median absolute deviation from 2%	Percent > 5%	Percent < -5%	Median absolute deviation from median ^a	Median	Mean (SD)
Thought of a specific price	52.2%	3.00 ⁿ	22.9%	6.3%	3.00 ⁿ	3.00	3.79 (7.04)
Did not think of a specific price	47.8%	2.00	18.2%	.0%	1.75	1.75	3.51 (5.33)
All	100.0%	2.00	20.7%	3.3%	2.00	2.00	3.66 (6.25)

Note: Mann-Whitney tests were used to test for group differences in medians; Chi-square tests were used to test for group differences in percent of participants.

^a=Median absolute deviation from the median observed for that group

ⁿ=significantly larger than for participants who did not think of a specific price (two-sided test; $p < .05$)

Table 6: Specific items participants considered when reporting inflation expectations (Study 2).

Item	Percent of respondents	Median expectation			Median absolute deviation from 2%			Percent >5%			Percent <-5%		
		Gas	Food	Housing	Gas	Food	Housing	Gas	Food	Housing	Gas	Food	Housing
Any	52.2%	5.00	3.00	.00	4.50	3.00	2.00	45.8%	20.8%	15.6%	2.1%	2.1%	17.8%
Food (including beverages)	26.1%	5.00	3.00 ¹	.00	5.00	5.00 ¹	.00	41.7%	12.5% ¹	17.4%	.0%	4.2%	8.7%
Gas (including transportation)	16.3%	10.00	2.00	.00	8.00 ¹	2.00	3.00	60.0%	26.7%	7.7%	.0%	.0%	23.1%
Housing (including utilities)	7.6%	3.00	5.00	2.00	5.00	3.00	1.00	42.9%	28.6%	28.6%	14.3%	.0%	28.6%
Clothing	3.3%	2.00	2.00	.00									
None	47.8%	4.00	2.00	.00	3.00	2.00	2.00	34.1%	15.9%	9.1%	6.8%	2.3%	18.2%
All	100.0%	5.00	2.00	.00	3.50	2.00	2.00	47.0%	32.0%	22.2%	3.2%	1.6%	8.4%

Note: Mann-Whitney tests were used to test for group differences in medians; Chi-square tests were used to test for group differences in percent of participants.

¹ = significantly larger than respondents who did not think of this price

Table 7: Regression models predicting extremeness and dispersion of reported inflation expectations (Study 2).^a

Variables	Linear regression (β)				
	Model 1 ($R^2=.12$)	Model 2 ($R^2=.60$)	Model 3 ($R^2=.17$)	Model 4 ($R^2=.62$)	Model 5 ($R^2=.69$)
<i>Log-transformed extremeness of inflation expectations</i> ^a					
Thought of any specific price	.23*	.13 ⁺	-	-	-
Thought of gas prices	-	-	.26*	.15 ⁺	-.19
Thought of food prices	-	-	.10	.02	-.34*
Thought of housing prices	-	-	.27*	.16*	-.17
Log-transformed extremeness of gas expectation ^a		.34***	-	.32***	.26***
Log-transformed extremeness of food expectation ^a		.34***	-	.35***	.25**
Log-transformed extremeness of housing expectation ^a		.25***	-	.23**	.12
Thought x gas expectation		-	-	-	.39*
Thought x food expectation		-	-	-	.42**
Thought x housing expectation		-	-	-	.42**
<i>Log-transformed dispersion of inflation expectations</i> ^b					
Thought of any specific price	.29*	.18*	-	-	-
Thought of gas prices	-	-	.22 ⁺	.11	-.08
Thought of food prices	-	-	.14	.06	-.16
Thought of housing prices	-	-	.31***	.20*	-.06
Log-transformed extremeness of gas expectation ^a		.29**		.28**	.24*
Log-transformed extremeness of food expectation ^a		.33***		.34***	.28**
Log-transformed extremeness of housing expectation ^a		.26**		.25**	.16 ⁺
Thought x gas expectation					.22
Thought x food expectation					.26
Thought x housing expectation					.33*

*** $p < .001$, ** $p < .01$, * $p < .05$

^a Log-transformed absolute deviation from 2%

^b Log-transformed absolute deviation from the group median

Note: All models included demographic controls for age, gender, income being below the median, having no college degree, and being non-white. Results were similar without controls.