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Abstract

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JEL Classification: E31, E52, E32

Keywords:

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A KISS for central bank communication in times of high inflation*

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Abstract

During the post-pandemic inflation surge, many central banks actively used communication about the inflation outlook as a policy tool to limit spillovers from realized to expected inflation. We present novel survey evidence showing that the ECB's guidance about the projected inflation path substantially lowers households' inflation expectations in times of unusually high inflation. A reassuring, positively framed non-quantitative communication style has the largest treatment effects on short-term expected inflation. Providing simple visualizations of the ECB's projected inflation path also significantly lowered inflation expectations across horizons. We document substantial heterogeneity of these effects along key socio-demographic characteristics. Our findings suggest that, regarding their communication, central banks should 'keep it sophisticatedly simple (KISS)'.

Keywords: Inflation projections, Central Bank Communication, Inflation Expectations, Randomized Control Trial, Survey Data.

JEL classification: E31, E52, E32

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1 Introduction

In the wake of the COVID-19 pandemic and the onset of the Russian war against Ukraine, central banks worldwide struggled to contain inflation. The ECB, which targets an annual inflation rate of 2% over the medium term, is a case in point. As illustrated by Figure 1, euro area inflation peaked at more than 10% in the fall of 2022, reaching double digits for the first time since the start of the monetary union. When inflation rates run substantially above the central bank's target over a prolonged period of time, inflation expectations risk de-anchoring. This can potentially contribute to an increased persistence of the inflation process, making it ever more costly to bring inflation back to target. To fight the inflation surge, the ECB, like many other central banks, therefore tightened monetary policy sharply. When communicating the first in a series of rate hikes, the ECB Governing Council highlighted that these measures *'will support the return of inflation to the Governing Council's medium-term target by strengthening the anchoring of inflation expectations'.*

The ECB's introductory statement acknowledges that the transmission process critically hinges on anchoring inflation expectations at the central bank's target. As a consequence, actively communicating with the general public has become a crucial element of its toolkit for managing inflation expectations, as laid out in the ECB's recent strategy review (Assenmacher et al., 2021). While there is now ample evidence about the effects of central bank communication on individuals' subjective inflation expectations in normal times, to this date little is known about the extent to which central bank communication can guide household inflation expectations when inflation is high and volatile.[1] Moreover, although consumers tend to pay more attention to inflation when it is high (Link et al., 2023), traditional ways of communicating with households may not suffice to induce shifts in their beliefs to eventually return expectations back to target (Weber and D'Acunto, 2024).[2] Tailored, understandable communication is ever more important when consumers have an incomplete or false understanding of how traditional monetary policy tools work (Andre et al., 2022).

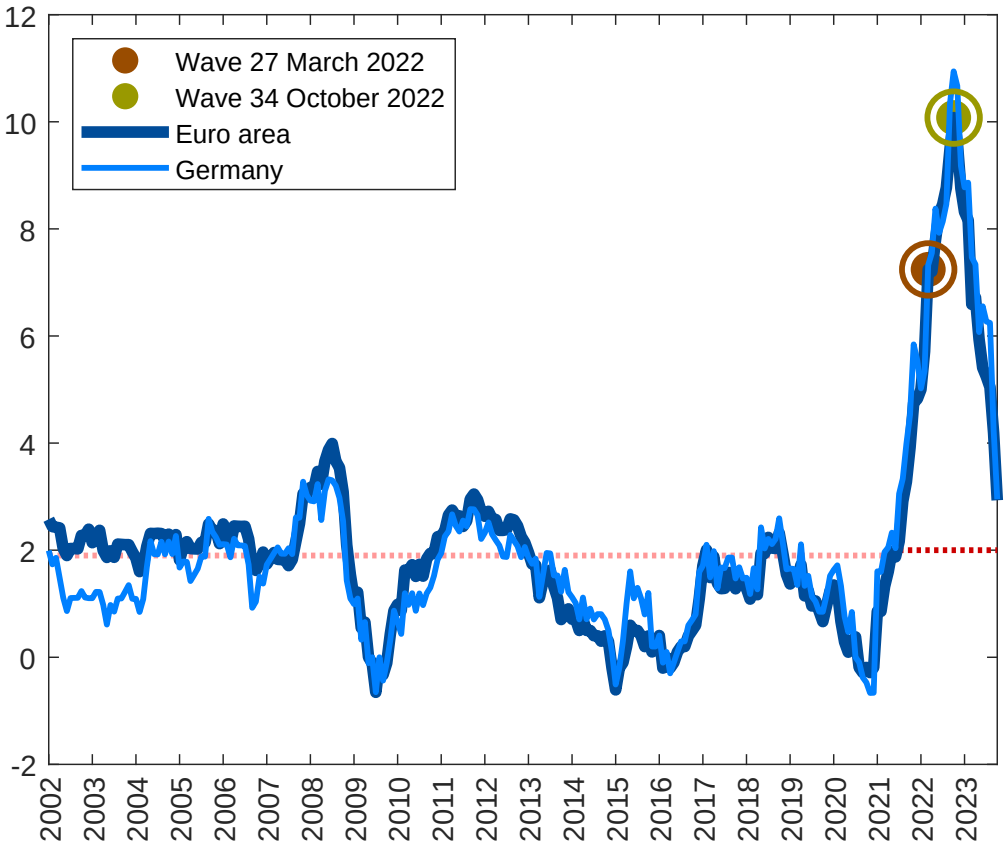
In this paper, we study the extent to which central bank communication can guide households' inflation expectations in extraordinary times. To this end, we designed a survey experiment employing different types of communication — numerical, verbal, and visual — to understand which is most effective in steering inflation expectations in the desired direction. In two large randomized control trials (RCTs), conducted in the Bundesbank Online Panel Households (BOP-HH), survey participants received different pieces of ECB communication information about the inflation outlook. Importantly, we only provide genuine pieces of communication that were actively used by the ECB and its representatives in 2022.

A key aspect of our analysis is that we elicit subjective distributions of the expected inflation rate during times of high and volatile inflation. Our first experiment was fielded in March 2022,

[1] See Blinder et al. (2022) and Weber and D'Acunto (2024) for an overview.

[2] Link et al. (2023) report that whereas in December 2020, only about 3% of surveyed households in Germany are attentive towards inflation, by 2022 this fraction increases to almost 40%.

Figure 1: Annual inflation rates for the euro area and Germany.



Notes: The solid dark blue line plots monthly year-on-year HICP inflation rates for the euro area. The thinner solid light blue line plots the corresponding time series for Germany. The encircled orange dot corresponds to the inflation rate observation in March 2022 (euro area: 7.24%, Germany: 7.32%), when the Bundesbank Online-Panel Households (BOP-HH) survey Wave 27 was fielded. The encircled yellow dot corresponds to the inflation rate observation in October 2022 (euro area: 10.08%; Germany: 10.94%), when BOP-HH Wave 34 was fielded. The horizontal dashed lines plot a 'close to but below 2%' inflation aim at 1.9 for illustration until July 2021, and the 2% inflation target (introduced in July 2021) thereafter.

when inflation was rising sharply, as shown in Figure 1. The second experiment was conducted in October 2022, when realized inflation in the euro area and Germany reached historical peaks of more than 10%, as depicted in Figure 1. Eliciting expectations at these two junctures allows us to assess the responsiveness of inflation expectations to communication in a period of unusual inflation dynamics.

Our results can be summarized as follows. We find that a qualitative and nontechnical account of the inflation outlook, particularly with positively framed language, significantly reduces households' inflation expectations. At the same time, verbally describing the inflation outlook with numerical statements elicits only a small response. Hence, when it comes to central bank communication, we find that 'words speak louder than numbers'. Moreover, we find that displaying the projected return of inflation back to target in a simple graphical format has the strongest impact on households' inflation expectations, particularly at longer forecast horizons. Hence, a simple chart appears more effective than summarizing the same numbers verbally in a press statement. Providing the same information in a table has a smaller, but still statistically significant impact. Based on these findings, we conclude that central banks should follow the KISS principle for their

communication with the general public and '**k**eep **i**t **s**ophisticatedly **s**imple'.[3]

Beyond this key result, we also show that households are attentive to central bank communication in times of high inflation, and when provided with information by the central bank, they actively incorporate it into their beliefs. Moreover, we find that individual uncertainty about the inflation outlook is significantly reduced by central bank information at short horizons. We also document interesting heterogeneity across households. For example, verbal communication seems to be more powerful in reducing expected inflation among individuals with lower levels of education. Moreover, while male participants appear to be more responsive to numbers and visual representations, verbal communication in a soothing, reassuring tone seems to resonate the most with women and respondents from East Germany.

These findings complement the current debate on how the public's (in)attention regarding the inflationary environment and central bank policies affect the transmission of monetary policy, see e.g. Cavallo et al. (2017), Coibion et al. (2023), Roth et al. (2023) and Weber et al. (2025). More precisely, our paper adds to the growing literature studying the effects of central bank communication with the general public, as recently surveyed by Blinder et al. (2022). Previous work has shown that in times of low and stable inflation, agents do not devote much attention to monetary policy (van der Cruijsen et al., 2015) and inflation developments (Kumar et al., 2015), or are even more inattentive if they do not understand the central bank's aims and how these affect economic and their personal conditions (Binder, 2017). Yet, Coibion et al. (2023), Coibion et al. (2022), and Galati et al. (2022) find that providing households with information about the central bank's inflation target steers inflation expectations towards the target. Similar effects have been observed when the message's content concerns the inflation forecast (Coibion et al., 2022) or its policy instruments (Coibion et al., 2023; Brouwer and de Haan, 2022). Furthermore, Ehrmann et al. (2023) find that providing survey respondents with information about the ECB's new inflation objective as of July 2021 affects both expected inflation and the confidence that the ECB will deliver price stability.

The evidence is more mixed regarding communication about changes in the central bank's monetary policy strategy. Hoffmann et al. (2022) show that households in Germany incorporate information about hypothetical changes in the ECB's monetary policy strategy into their expectation formation process. This somewhat stands in contrast to Coibion et al. (2023) who document that the Fed's announcement of adopting flexible average inflation targeting did not resonate among U.S. households. Hoffmann et al. (2023) further document that German survey respondents make little difference between the previous ECB strategy of targeting inflation rates close to but below 2% and the new strategy with a symmetric 2% target. When informed that the ECB might tolerate above-target inflation for some time, however, participants increase their medium-term inflation expectations, but only when inflation is currently running below target.

[3]The KISS principle is rather a widely used motto than a theoretical construct. The KISS acronym was most likely popularized by aircraft engineer C.L. Johnson. Further information is provided at https://www.lockheedmartin.com/en-us/news/features/history/johnson.html.

While the above studies focus primarily on the content of the central bank's message, another strand of literature studies aspects such as clarity (Ferrara and Angino, 2022; Bulíř et al., 2013), transparency (Hansen et al., 2018; Bjerkander and Glas, 2024), tone (Hubert and Labondance, 2021), its messenger (D'Acunto et al., 2022), or medium Ash et al. (2024). Bholat et al. (2019) and Haldane and McMahon (2018) analyze the effect of 'layered' central bank communication as implemented by the Bank of England on people's comprehension of the conveyed information. Both studies outline the benefits of reduced complexity and the use of simple, relatable language to boost gains from communication to both traditional and more general audiences. In a laboratory experiment, Kryvtsov and Petersen (2021) confirm these findings by analyzing the effect of different types of forward guidance on individual and aggregated outcomes. Further, Rholes and Petersen (2021) and Kostyshyna and Petersen (2023) provide empirical evidence on how central banks can communicate uncertainty around their inflation projections. Dräger et al. (2024) use a randomized control trial to show that information about rising inflation increases inflation expectations, but the increase can be mitigated by showing inflation forecasts.

The paper is organized as follows. Section 2 describes the experimental module fielded in March and October 2022, explains the treatments and discusses characteristics of the data set. In Section 3, we show the regression analysis to quantify treatment effects from different communication formats on individuals' mean inflation expectations. Section 4 discusses a Bayesian learning approach to study how respondents weigh central bank information when updating their beliefs. Section 5 concludes.

2 Data and experimental design

The survey experiments presented in this study were performed within the Bundesbank Online Panel Households (BOP-HH). The BOP-HH is a survey conducted at a monthly frequency to elicit consumer expectations about both macroeconomic and household-specific outcomes and is representative of the German online population aged 16 and above.[4] The survey contains a core module of general interest questions. In addition, our extracurricular communication module was fielded twice as a randomized control trial (RCT). The first RCT was run in March 2022, and is based on 5,120 complete responses. The second RCT, using a slightly different design, was run in October 2022 and collected 4,756 complete responses. As shown in Figure 1, these two dates reflect points in time when euro area inflation was historically very high.

2.1 Eliciting the term structure of inflation expectations

The first stage of the RCT aims at collecting prior expectations. As part of the core module of the survey, respondents are asked a qualitative, a point forecast, and a probabilistic question for

[4]The German-language questionnaires and English-language translations are available at: https://www.bundesbank.de/en/bundesbank/research/survey-on-consumer-expectations-bop-hh.

short-term inflation in Germany. In addition, we elicit both short-term expected inflation (1Y ahead) as well as households' beliefs over the medium term (2-3Y ahead) and over longer horizons (5-10Y ahead). Data for all horizons are collected separately as probabilistic assessments, asking each participant to assign probabilities to a predefined set of bins. To avoid repetition of the core module design, in either survey wave, the bin definitions were chosen to align with the ECB's most recent projections published before the fielding of the questionnaire. This allows us to maintain tractability while still attaining a sufficiently precise grid. Specifically, for the March 2022 survey wave, we chose a six-bin only format: $(-\infty, 1], (1; 2], (2; 3], (3; 4], (4, 5], (5, \infty)$. By October 2022 (Wave 34), inflation rates had risen to new heights, and the histogram support needed to be adjusted. Thus, we added two more bins for expected inflation of $(5; 6]$ and $(6; 7]$, and a new right outer bin assuming probabilities for $\pi^e > 7\%$.

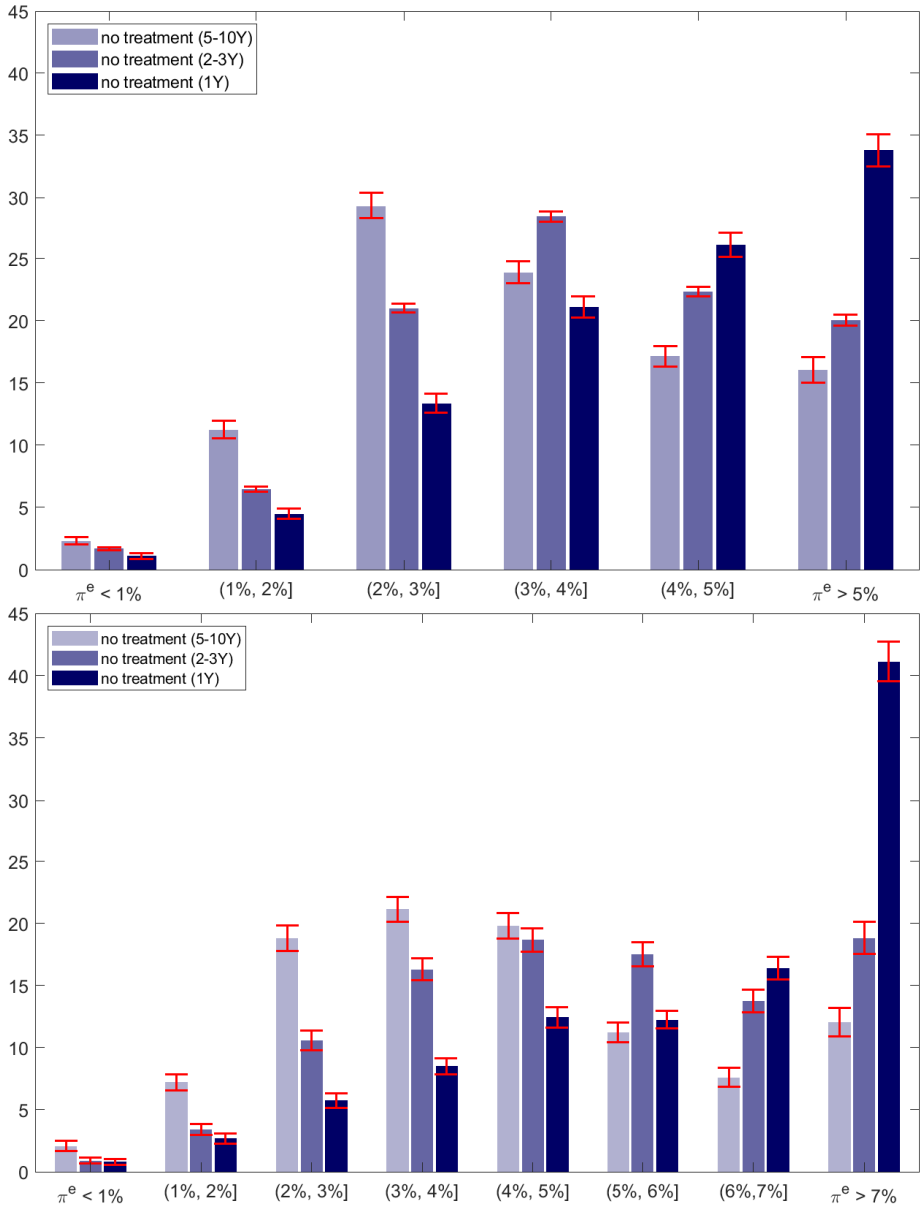
The survey is designed as follows. First, all participants receive a short introductory text that the ECB is targeting inflation at 2% over the medium term. Then they are given a probabilistic question about their assessment of inflation two to three years out. They can assign any number between 0 and 100 to each bin such that probabilities sum to one hundred. If this condition is not met, an error message is displayed. Roughly 30% of the participants use only one bin when answering the question.To minimize survey fatigue, we refrain from collecting inflation expectations for all three forecast horizons both before and after the information treatment, which would have required participants to fill six histograms in our communication module only. Instead, we collect both prior and posterior expectations for inflation for the medium term (2-3Y) and utilize split sampling with genuine control groups for the other two horizons. As the 2-3Y time frame corresponds to the ECB's policy horizon, we also study individuals' inflation updating behavior for this most important forecast horizon in Section 4.

2.2 A look at a-priori expected inflation

The results of the first stage from both survey waves are shown in Figure 2. Households' probabilistic assessments for inflation as of March 2022 are plotted in the top panel. The bars show subjective probabilities averaged across respondents, and as such the figure represents the cross-sectional distribution of a-priori expected inflation. We depict all three forecast horizons in one figure to illustrate the term structure of inflation expectations. The dark bars show that, at the one-year horizon, participants attribute most of the probability mass to higher inflation outcomes and very little mass to outcomes below 2%. Medium blue bars, in turn, show 2-3Y expectations centered around the 3-4% bin, whereas light blue bars indicate that longer-term expected inflation attracted considerably more mass around the 2-3% bin. As the chart suggests, although households on average expect a sharp rise in inflation in Germany, they also see rates gradually subsiding in a few years. Hence, survey participants had a largely 'transitory' view of the inflationary environment in March 2022.

By October 2022, euro area inflation had risen to a historical peak of above 10%. The bottom panel of Figure 2 shows that household inflation expectations in Germany adjusted to the further rise in inflation. On average, participants assign almost a 50% chance of inflation lying above 7% in the next twelve months. Overall, the distributions for medium and longer-term inflation now center at higher values, around the 4-5% (medium) and 3-4% (longer run) bin, respectively. Hence, while households expect inflationary pressures to ease at this point, they also see inflation rates solidifying above the ECB's 2% target for several years.

Figure 2: Pre-treatment inflation expectations for 1Y, 2-3Y and 5-10Y ahead — March and October 2022



Notes: Dark blue bars show average subjective inflation probabilities for 1Y ahead, medium blue bars for 2-3Y ahead, and light blue bars for 5-10Y ahead. A one-standard-error band is plotted in red. The top panel displays results for March 2022 Wave 27, and the bottom panel for October 2022 Wave 34 of BOP-HH.

Table 1: Treatments used in BOP-HH Wave 27 March 2022

Treatment 'forecast' The European Central Bank (ECB) aims at an inflation target of 2% over the medium term. The ECB's current projections from March 2022 forecast inflation rates of 5.1% for 2022, 2.1% for 2023, and 1.9%. for 2024.
Treatment 'forecast ext.' The European Central Bank (ECB) aims at an inflation target of 2% over the medium term. In December 2021, the ECB had forecast inflation rates of 3.2% for 2022 and 1.8% for both 2023 and 2024. The ECB's current projections from March 2022 now forecast inflation rates of 5.1% for 2022, 2.1% for 2023, and 1.9% for 2024.
Treatment 'Lane' The European Central Bank (ECB) aims at an inflation target of 2% over the medium term. In an interview conducted on 11 January 2022, ECB Chief Economist Philip Lane stated that *'[...] we also believe that inflation will fall this year, and that it will go below our 2 per cent target in 2023 and 2024.'*
Treatment 'Lane ext.' Treatment 'Lane', adding: Mr Lane also said that he did not see changes in household and firm wage behaviour that would suggest inflation would remain above the inflation target into the medium term.
Treatment 'Nagel' The European Central Bank (ECB) aims at an inflation target of 2% over the medium term. In December 2021, the ECB had forecast inflation rates of 3.2% for 2022 and 1.8% for both 2023 and 2024. The ECB's current projections from March 2022 now forecast inflation rates of 5.1% for 2022, 2.1% for 2023, and 1.9% for 2024. On 11 January 2022, the new Bundesbank President Joachim Nagel warned that he saw a risk that *'[...] the inflation rate could remain elevated for longer than expected at the current time.'* He stated that *'[...] the ECB Governing Council must act and adapt its monetary policy stance where doing so is needed to safeguard price stability.'*
Text for control group Now we would like to ask you about the path you expect inflation to take in the coming years. The European Central Bank (ECB) aims at an inflation target of 2% over the medium term.

2.3 Treatment design

Before soliciting their medium-term prior inflation expectations, all survey participants receive the same information about the ECB's inflation target of 2% by way of a short introductory text (see Tables 1 and 2). Previous studies such as Coibion et al. (2022) and Ehrmann et al. (2023) have established that providing information about the central bank's inflation target alone can already have a significant impact on inflation expectations during normal times. By providing all respondents with basic information about the ECB's inflation target, we intend to measure what effect *additional* communication can have on households' expectations about future price growth.

Once all survey respondents have been queried about their probabilistic medium-term inflation forecast, the questionnaire continues with the treatment stage. In this step, the entire sample is randomly split into five (March 2022) or eight (October 2022) equally large groups. In each group, participants are provided with a specific piece of genuine ECB communication about the inflation outlook. In both survey waves, we use communication pieces that we categorize as 'verbal' and 'numerical' treatments. Additional treatments in the category 'visual' were implemented in the October 2022 wave. In either survey wave, there is a control group which does not receive any additional information. This allows us to track inflation expectations of the treated individuals relative to those participants who only received information about the 2% inflation target. In the final stage of the experiment, we collect posterior probabilistic inflation assessments for short- and long-term forecast horizons.

2.3.1 Treatments in the category 'numerical'

The most common way for central banks to communicate the inflation outlook is via short summaries of their current projections of overall price growth. Traditionally targeting financial markets, such communication is shown to be successful in managing market and professional forecasters' expectations (Hubert, 2015; Binder and Sekkel, 2023), and, to a certain extent, the expectations of the broader public (Coibion et al., 2022).

The treatments used in both waves are shown in Tables 1 (March 2022) and 2 (October 2022), respectively. In the category 'numerical', the treatments 'forecast' provide participants with the most recent ECB inflation projections at the time the survey was fielded. For the March wave, we relied on the March 2022 projections for 2022, 2023, and 2024. For the October wave, the corresponding September 2022 projections were employed. In addition to the simple projections, we also use an extended text (labelled 'forecast ext.') in both survey rounds. These include the current and the preceding projection figures. Hence, in both cases the treatment texts inform participants that the ECB's inflation projections were revised upwards.

2.3.2 Treatments in the category 'visual'

One of the conclusions of the ECB's 2021 strategy review was that the central bank would increase its outreach to the wider audience, in an effort to enhance accountability and legitimacy (Assenmacher et al., 2021). Among other things, the ECB applies so-called layered communication – a combination of text and visualizations – which varies the degree of detail of information to appeal to various audiences. A novel communication element introduced since the strategy review is the so-called 'visual statement', a graphical illustration summarizing recent monetary policy decisions and the projected economic outlook, published regularly on the ECB website. We mimic this approach in our analysis by including two treatments in the category 'visual'.

Specifically, as shown in Table 2, the treatment 'graph' provides a screenshot of the September 2022 visual statement, depicting the projected path for future inflation, as shown in Table 2.[5] This is a graphical illustration of the same projections which respondents receive in the 'forecast' treatment, but also reports realized 2021 inflation at 2.6%. Thus the projected path assumes a hump-shaped profile of inflation. While it shows inflation rising initially, it suggests a return towards the ECB's inflation target in subsequent years, implying that the projected rise of inflation is viewed as transitory. In addition, the ECB typically publishes the key quarterly economic projections for euro area GDP growth and HICP inflation in a table format on the bank's website. Therefore, our treatment 'table' reproduces the two most recent inflation projections in a simplified and tractable way. Its numerical content exactly corresponds to the treatment 'forecast ext.', but the representation of the information is different. The information is now shown in a visualized table format.

[5]The corresponding original ECB information is available at https://www.ecb.europa.eu/press/pressconf/visual-mps/2022/html/mopo_statement_explained_september.en.html

Table 2: Treatments used in BOP-HH Wave 34 October 2022

Treatment 'forecast'
The European Central Bank (ECB) aims at an inflation target of 2% over the medium term for the euro area. The ECB's current projections from September 2022 forecast inflation rates of 8.1% for 2022, 5.5% for 2023, and 2.3% for 2024.

Treatment 'forecast ext.'
The European Central Bank (ECB) aims at an inflation target of 2% over the medium term for the euro area. In June 2022, the ECB had forecast inflation rates of 6.8% for 2022, 3.5% for 2023 and 2.1% for 2024. The ECB's current projections from September 2022 now forecast inflation rates of 8.1% for 2022, 5.5% for 2023, and 2.3% for 2024.

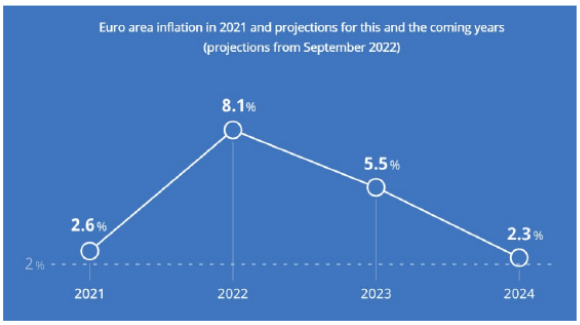
Treatment 'Nagel'
The European Central Bank (ECB) aims at an inflation target of 2% over the medium term for the euro area. In an interview with the 'Rheinische Post' newspaper on 20 August, Bundesbank President Joachim Nagel expressed his concern about the current inflation rates. *'Overall, an inflation rate of 10% is even possible in the autumn months. [...] There is a growing probability that inflation will be higher than previously forecast and that, on average next year, we will have a six before the decimal point.'*

Treatment 'Nagel ext.'
Treatment 'Nagel', adding:
He explained: *'In order to achieve our objective, we gave a marked signal at our ECB Governing Council meeting on 21 July. We raised the key interest rate by half a percentage point and signaled further steps. [...] Given the high rates of inflation, further interest rate steps need to be taken.'*
The ECB subsequently raised the key interest rates again by 0.75 percentage points in its decision on interest rates of 8 September.

Treatment 'Schnabel'
The European Central Bank (ECB) aims at an inflation target of 2% over the medium term for the euro area. In a widely regarded speech at the Economic Policy Symposium - an annual meeting of key central bankers in Jackson Hole (Wyoming, United States) - at the end of August, German ECB Executive Board member Isabel Schnabel stated that *'high inflation has become the dominant concern of citizens in many countries'*. She highlighted that central banks would have to act forcefully in times of high inflation so that the general public would not lose confidence in central banks bringing inflation back down to the 2% target. The ECB subsequently raised the key interest rates again by 0.75 percentage points in its decision on interest rates of 8 September.

Treatment 'graph'

The European Central Bank (ECB) aims at an inflation target of 2% over the medium term. The latest projections from September 2022 are shown in the chart from the ECB's website below:



Treatment 'table'

The European Central Bank (ECB) aims at an inflation target of 2% over the medium term for the euro area.
In June 2022, the ECB had forecast the following inflation rates:

	2022	2023	2024
Euro area HICP (i), annual percentage changes	6.8	3.5	2.1

The latest ECB projections from September 2022 now forecast the following inflation rates:

	2022	2023	2024
Euro area HICP (i), annual percentage changes	8.1	5.5	2.3

Text for control group
The European Central Bank (ECB) aims at an inflation target of 2% over the medium term. Now we would like to ask you about the path you expect inflation to take in the coming years.

2.3.3 Treatments in the category 'verbal'

The general public's attention as well as the demand for information on price developments usually increases in a high inflation environment. As a result, central banker speeches, interviews and their media coverage may become a source of information for households. To capture the effects of this type of communication on inflation expectations, we include treatments from the category 'verbal' in both waves. The treatment texts consist of short summaries or excerpts from interviews given by different members of the ECB Governing Council throughout 2022.[6]

In early 2022, ECB Chief Economist Philip Lane was one of the main communicators, giving many interviews about the ECB's euro area inflation outlook. A core element in Lane's explanations of the outlook during that period was the emphasis on the transitory nature of the inflationary increase. As featured in the treatment 'Lane' in Table 1, Chief Economist Lane usually omitted any precise projection figures in his explanations, avoiding quantifying the current-year projections, which were, at that time, record-high figures following a record-high forecast revision.[7] In addition, his communication about the inflation outlook was purposefully framed in benign terms. Moreover, Lane conveyed the projected inflation outlook in a largely non-technical, qualitative manner. This was likely done with two objectives in mind: first, to make the information accessible to a wider audience, and, second, to circumvent risks of planting a high anchor value into people's perceptions. The expression of his confidence in inflation rates returning to target is further emphasized in the extended treatment 'Lane ext.', shown in Table 1, which adds ECB Chief Economist Lane's explanations about the economy not showing indications of a wage-price spiral.

A similarly reassuring communication style was adopted by ECB Executive Board member Isabel Schnabel throughout 2022. She also largely omitted the use of numbers in her interviews and speeches. For the treatment *'Schnabel'* we use elements of her 2022 Jackson Hole speech, as shown in Table 2.[8] While the statement no longer emphasizes the temporary nature of inflation and is not necessarily positive in tone, the use of simple, relatable, and reassuring language by directly addressing citizens' concerns can be expected to increase participants' understanding and comprehension of the policy measures, as suggested by (Bholat et al., 2019). Furthermore, the choice of words such as 'widely regarded' or 'confidence' can be perceived as suggesting a high credibility of the speaker. Thus, the treatment text not only provides information about the inflation outlook, but emphasizes the ECB's commitment to its inflation target and the action taken to return to it. Although the statement does not entirely omit numbers, it features very low values ('0.75%') of the interest rates rather than referring to the high values of the inflation projections, a feature that may be salient to respondents.

[6] Dräger et al. (2022) consider a similar subdivision into qualitative and quantitative information.

[7] An account is provided in the respective projection reports at https://www.ecb.europa.eu/pub/projections/html/all-releases.en.html.

[8] Isabel Schnabel's Jackson Hole speech can be found at https://www.ecb.europa.eu/press/key/date/2022/html/ecb.sp220827~93f7d07535.en.html.

As a contrast to this communication style, we also include treatment texts that rely heavily on numerical values. In a newspaper interview from August 2022 (treatment 'Nagel'), Bundesbank President Joachim Nagel expresses his concerns about the high current inflation rates.[9] In his answers, President Nagel used a rather technical communication style, referring to the projections as first rising further before starting to decline. President Nagel also provides a new forecast for inflation of 10%. While his assessment is certainly backed by the Eurosystem's inflation projection uncertainty bands at the time, one might expect such a statement to provide a focal point of inflation expectations for the readers. Similarly to the treatment 'Schnabel', the treatment text 'Nagel ext.' adds information about the ECB's interest rate hike, an element which potentially counteracts the rather alarming language in Nagel's main statement.

3 Central bank communication and expected inflation

This section analyzes the effects of the various communication styles by documenting the implied shifts in reported inflation expectations. Extended results regarding the heterogeneity of treatment effects as well as effects on inflation uncertainty are summarized and reported in detail in the Appendix.

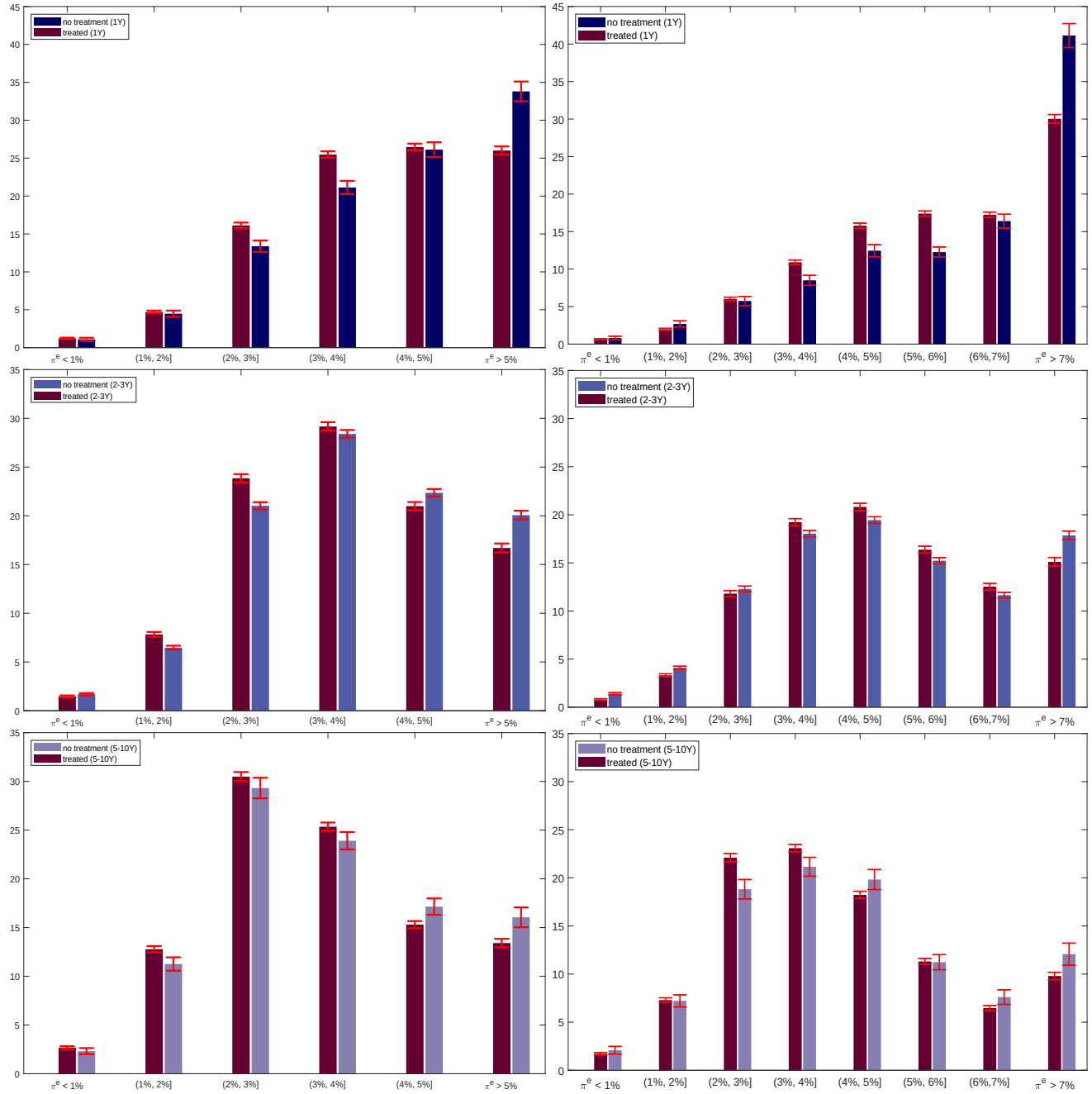
3.1 Central bank communication shifts expected inflation

Figure 3 shows the average subjective probabilities collected in March and October 2022 in the left and right column, respectively. The bars display the probability assigned to each of the pre-defined intervals, averaged across all respondents. The top row plots expected inflation for the short term (1Y ahead), the middle row for the medium term (2-3Y ahead), and the bottom row for the longer term (5-10Y ahead). Blue bars correspond to the a-priori assessments from Figure 2, now displayed for each expectation horizon separately. Dark red bars, in turn, plot a-posteriori average subjective probabilities, pooled over all treated survey participants. For both survey rounds, we observe that communication about the inflation outlook leads to a significant shift in the perceived probability distribution of near-term inflation, particularly in the upper tail of the distribution. For example, as shown in the top-right panel for one-year ahead expectations solicited in October 2022, across treatment groups communication lowers the reported probability for inflation exceeding 7% by eleven percentage points (41% in the control group as opposed to 30% in the treated group).

Although less pronounced, the effects of central bank communication are also economically and statistically significant for medium- and longer-term expectations. As the dark red bars in the middle and bottom panels of Figure 3 indicate, expectations for inflation 2-3 and 5-10 years

[9]Bundesbank President Joachim Nagel's Rheinische Post interview is provided at https://rp-online.de/wirtschaft/finanzen/joachim-nagel-haelt-inflationsrate-von-zehn-prozent-fuer-moeglich_aid-75357091.

Figure 3: Inflation expectations for 1Y, 2-3Y and 5-10Y ahead: untreated vs. pooled across treatment — March 2022 (left) and October 2022 (right)



Notes: Left panel displays the results for March 2022, right panel for the October 2022 wave. Dark blue (medium blue, light blue) bars in the top (middle, bottom) panel show average subjective probabilities for 1Y (2-3Y, 5-10Y) ahead of untreated individuals. Dark red bars show average subjective probabilities for 1Y (2-3Y, 5-10Y) ahead of treated individuals, pooled across all treatment groups. A one-standard-error band is plotted in red.

ahead shift closer to the target. While the distributions attain hump-shaped profiles, they are quite far from being centered around the important 2% mark. As an intermediate summary, in both the March and the October 2022 wave, communication seems to work well in steering households' expected inflation toward the target. However, as the re-distribution of probabilities after treatment occurs mainly in the bins above 2%, it is unclear from these charts by how much the average expected inflation rate in the survey sample is revised downwards. In the next section, we therefore study how respondents' mean expected inflation responds to central bank communication.

3.2 Measuring average treatment effects

Having established that central bank communication is effective in shifting the distribution of inflation expectations, we now take a more granular look at the impact of the specific treatments. Specifically, following standard methodology, we derive the individual implied means from the respondents' histograms, and use them as the dependent variable in a simple regression analysis.[10] More precisely, we regress posterior beliefs on a constant β_0, a set of dummy variables $d_{s,i}$ that indicate which treatment group s a respondent i was randomly sampled into, and a set of socio-economic control variables X_j:

$$\text{mean}_i^{post} = \beta_0 + \sum_s^S \beta_s d_{s,i} + \gamma_j X_j + \varepsilon_i. \tag{1}$$

We run these regressions separately for each horizon and omit the corresponding horizon index h for simplicity. Equation (1) implies that the estimate for the parameter β_0 captures the mean expected inflation of the control group for each forecast horizon. Estimates for β_s, in turn, measure the average treatment effects relative to the control group for the various communication treatments s. The results from estimating Equation (1) are reported in Table 3 for March 2022 and Table 4 for October 2022, respectively. We now discuss them in detail.

3.2.1 March 2022 — Words speak louder than numbers

As shown in Table 3, in early 2022 average expected inflation one year out stood at 4.39%. With $\hat{\beta}_0$ for 2-3Y ahead estimated at 4.28% and for 5-10Y at 3.78%, the term structure of average expected inflation is slightly downward-sloping. Hence, survey participants expected inflation to materialize substantially above the ECB's 2% target at all horizons. Providing households with some information on the inflation outlook, shown as β_s^{pooled}, lowers expected inflation by

[10] We follow Engelberg et al. (2009) and fit a Generalized Beta distribution to all histograms using more than two bins. For the one- and two-bin cases, we fit a symmetric triangular distribution to the histograms. If the respondent uses one or both half-open bins, we assume that the width of the respective bin equals twice the width of the neighboring bin (triangular distribution) or estimate the corresponding endpoint within this range (GBeta). For further discussion, see Krüger and Pavlova (2024) and Pavlova (2025).

Table 3: Average treatment effects for mean expected inflation — Wave 27 March 2022

	$1Y$	$2-3Y$	$5-10Y$
	Estimation w/ all treatments pooled		
β_0^{pooled}	4.39***	4.28***	3.78***
	(0.11)	(0.10)	(0.09)
β_s^{pooled}	−0.20***	−0.13***	−0.07
	(0.06)	(0.05)	(0.05)
	Estimation w/ all treatment dummies		
β_0 (control group)	4.41***	4.30***	3.79***
	(0.11)	(0.10)	(0.09)
β_s	treatment category 'numerical'		
'forecast'	−0.11	−0.11*	−0.08
	(0.07)	(0.06)	(0.06)
'forecast ext.'	−0.09	−0.09	0.03
	(0.07)	(0.06)	(0.06)
	treatment category 'verbal'		
'Lane'	−0.43***	−0.24***	−0.20***
	(0.07)	(0.06)	(0.06)
'Lane ext.'	−0.37***	−0.24***	−0.14**
	(0.07)	(0.06)	(0.06)
'Nagel'	0.00	0.00	0.04
	(0.07)	(0.06)	(0.06)
Observations	4,649	4,643	4,626

Notes: Standard errors reported in parentheses. Asterisks (***,** ,*) denote statistically significant differences at the 1%, 5%, and 10%-levels, respectively. All observations are weighted using survey weights.

a statistically significant 20 basis points in the short- and 13 basis points in the medium-term, respectively. At the 5-10 year horizon, the pooled average treatment is insignificant at negative seven basis points. While lowering inflation expectations, the pooled effect of the communication treatments is thus fairly modest relative to the high levels of expected inflation.

We now analyze the treatment effects individually, with the aim to determine which ones are the most effective in shaping household expectations. The bottom panel of Table 3 provides the individual treatment effects of the March 2022 survey. The two treatments 'forecast' and 'forecast ext.' in the category 'numerical' have only small and for the most part statistically insignificant effects. This stands in contrast to a previous literature documenting that central bank projections affect the expectations of professional forecasters (e.g. Hubert (2014) or Jain and Sutherland (2020)) and suggests that private households may be less prone to altering their views based on purely numerical information.

That said, in the treatment category 'verbal', both statements taken from the newspaper interview with ECB Chief Economist Philip Lane substantially lower households' average expected inflation for the short term by around 40 basis points, and also reduce the medium- and longer-term expectations by roughly 20 basis points. While these effects may appear economically small when compared with the average expected rate of inflation of around 4% across forecast horizons, they are in the ballpark of related work on the effects of central bank communication on household expectations (e.g. Coibion et al., 2022). The results are also economically meaningful when put

into perspective against the gains from stabilizing inflation in theoretical work. For example, Nakata and Schmidt (2019) show that a central bank which puts a higher weight on inflation stabilization can mitigate the inflationary bias by up to 30 basis points in the presence of liquidity traps at the zero lower bound.

We interpret the relative effectiveness of Lane's communication style in the following way. In his statement, he practically omits all current inflation figures and instead assures the public, in a qualitative manner, that the ECB's inflation target will be met at the end of the policy horizon. By focusing on future good news, Lane seems to counterbalance a negativity bias that some respondents may have, i.e. attaching greater weight to negative news or events as described by Rozin and Royzman (2001). Also, as summarized in Levine and Pizarro (2004), individuals experiencing positive and negative emotions process information differently. With positive emotion, there is an increased reliance on general knowledge and heuristics. By signaling confidence about achieving the price stability objective in the medium term, and avoiding any reference to the alarmingly high ECB projections, Chief Economist Lane provides a positive verbal framing for the current inflation environment. This potentially results in survey participants adopting Lane's views more easily and revising expectations downwards. A more recent economic literature on central bank communication with financial market participants, e.g. by Gorodnichenko et al. (2023) and Hubert and Labondance (2021), has also found a significant influence of a positive tone.

Interestingly, the verbal treatment 'Nagel', which emphasized the risk of a persistently higher inflationary path and as such adopts a different tone as the 'Lane' treatments, did not lead to a reduction in households' expected rate of inflation.[11] This suggests that policy makers pointing towards a higher or more long-lived inflationary episode may – purposefully or not – anchor the public's expectations at higher levels. We next turn to the effects of a broader set of central bank communication snippets in October 2022.

3.2.2 October 2022 — A picture is worth a thousand words

The results from this survey wave are provided in Table 4. Looking at the unconditional inflation expectations embodied by the coefficients $\hat{\beta}_0$, as of October 2022 the average expected inflation was substantially higher but the term structure of expected inflation more strongly downward-sloping compared to March 2022. While the negative slope of the term structure may be good news for policymakers, these numbers also indicate that households on average were far from expecting a full return to the 2% inflation target, even at longer horizons.

Looking at the overall effect of the information provision, captured by the coefficient β_s^{pooled} for all treatments combined, survey participants appear more susceptible to information provision as compared to March 2022. Across treatments, communication achieves a roughly 40 basis points

[11] Tillmann and Walter (2019) already observed that 'The tone of Bundesbank speeches is markedly more pessimistic than the tone of ECB communication'.

Table 4: Average treatment effects for mean expected inflation — Wave 34 October 2022

	1Y	2-3Y	5-10Y
	Estimation w/ all treatments pooled		
β_0^{pooled}	6.15***	5.48***	4.40***
	(0.18)	(0.18)	(0.16)
β_s^{pooled}	−0.37***	−0.21**	−0.21***
	(0.09)	(0.09)	(0.08)
	Estimation w/ treatment dummies		
β_0 (control group)	6.08***	5.47***	4.41***
	(0.18)	(0.18)	(0.16)
β_s	treatment category 'numerical'		
'forecast'	−0.26**	−0.25**	−0.20**
	(0.11)	(0.11)	(0.10)
'forecast ext.'	−0.48***	−0.26*	−0.17*
	(0.12)	(0.11)	(0.10)
	treatment category 'verbal'		
'Schnabel'	−0.77***	−0.30***	−0.26**
	(0.11)	(0.11)	(0.10)
'Nagel'	0.05	0.17	0.06
	(0.11)	(0.11)	(0.10)
'Nagel ext.'	−0.20*	0.00	−0.01
	(0.12)	(0.11)	(0.10)
	treatment category 'visual'		
'graph'	−0.61***	−0.56***	−0.54***
	(0.11)	(0.11)	(0.10)
'table'	−0.38***	−0.32***	−0.29***
	(0.11)	(0.11)	(0.10)
Observations	4,756	4,767	4,756

Notes: Standard errors reported in parentheses. Asterisks (***,** ,*) denote statistically significant differences at the 1%, 5%, and 10%-levels, respectively. All observations are weighted using survey weights.

reduction in average expected inflation in the short term and about 20 basis points for medium-term expectations. Contrary to the results from March 2022, we also see a marked reduction in expectations for the longer term. Overall, in the October wave we find economically and statistically significant effects across all horizons.

That said, looking at the individual treatment effects, we observe some interesting differences. In contrast to March 2022, both treatments in the category 'numerical' induce a substantial reduction in reported expectations at all horizons. Intriguingly, the treatment 'forecast ext.', providing information about an upward revision of the ECB inflation projections has a significant *negative* effect across all horizons. A likely explanation is that the ECB's revised projections for 2023 and 2024, while higher than the previous projection, were substantially below households' prior expectations for those years.

Among the 'verbal' treatments provided to survey participants in October 2022, the communication by ECB Governing Council member Isabel Schnabel achieves the largest reduction of average expected inflation.[12] The effect of treatment 'Schnabel' amounts to roughly 80 basis points for the short term, a remarkable reduction at a horizon over which conventional monetary

[12]F-tests on the differences across treatments are reported in Table 11 in the Appendix.

policy usually cannot assume its full effect, given the lags in monetary policy transmission. Since the ECB's price stability objective is defined for the medium term, it is worth noting that this treatment also shifts beliefs by a substantial and highly statistically significant −30 basis points at the 2-3Y and a roughly similar magnitude at the 5-10Y horizon.

In contrast, the treatment 'Nagel', while statistically insignificant, results in a small upward revision of individuals' inflation expectations. Arguably, Bundesbank President Joachim Nagel had a different intention than ECB Executive Board members Isabel Schnabel and Philipp Lane in his interview in the newspaper *Rheinische Post*, likely addressing the other members of the ECB's Governing Council rather than the general public. To raise awareness about the stronger monetary action required to fight inflation at that point in time, President Nagel points out that inflation could reach 10% in the autumn of 2022. While ex-post this prediction proved correct, it may have provided a higher numerical anchor for some survey participants.[13] Another aspect might be that individuals tend to memorize teen numbers particularly well (see, e.g. Milikowski and Elshout (1995)), and a large number may also heighten the immanent inflation aversion that is still measurable in survey data, as observed in Ehrmann and Tzamourani (2012). Interestingly, the treatment 'Nagel ext.', where President Nagel additionally notes the monetary policy measures already taken to combat high inflation rates, slightly lowers near-term inflation expectations. In sum, the results from both waves highlight the effectiveness of verbal communication. This is particularly true for the short run as shown by the highly statistically significant differences in treatment effects documented in Table 11 in Appendix A.

That said, as seen in the bottom panel of Table 4, conveying the inflation outlook using visuals proves equally potent in bringing elevated inflation expectations back towards the target. The effect of providing information in a tabular format is strong and highly statistically significant across all forecast horizons. The 'graph' treatment also consistently lowers inflation expectations across all horizons. For the 1Y ahead expectations, the estimated average treatment effect is a highly statistically significant −0.61, second only to the 'Schnabel' treatment. The effect of 'graph' is still strong for the medium and longer term (yielding reductions of 56 and 54 basis points, respectively). Overall, this suggests that communication via visualizations is the most effective across the entire term structure of expectations in our experiments. This finding also holds when comparing the statistical differences across treatments in Table 11.

As explained by Franconeri et al. (1987), effective graphics should avoid taxing working memory and help guide attention, 'provided that designers tailor those visualizations to their audience.' In this regard, the graphs used in the new ECB visual statements seem appealing to the survey respondents in our sample. For instance, the graph omits a Y-axis, and the X-axis is leveled in at the 2% inflation target. Furthermore, although 2023 inflation is predicted at a record-high 8.1%, the inclusion of the 2021 realized value of 2.6% and the projected return towards the target in

[13]This is consistent with Hubert (2014) who shows that the median of professional forecasters' current-year inflation predictions moves towards the FOMC forecasts, suggesting that the latter may act as a focal point for private inflation expectations.

2024 with inflation at 2.3% gives these developments a transitory character. Similar to the graph treatment in Binder and Rodrigue (2018), survey participants can relate the projected return of inflation to the target to a historical value in the not-so-distant past when inflation was low and stable. In addition, the blue background of the graph possibly contributes to its reassuring character, as a bluish hue is usually found pleasant and trustworthy (see for instance Valdez and Mehrabian (1994) or Su et al. (2019)). Overall, the ECB graph seems to be designed in a way that it can interact with the human visual system with little frictions and at low computational costs, as described in Larkin and Simon (1987).

We conclude from these results that central bank communication may effectively help to work against a de-anchoring of expectations in a period of elevated realized and expected inflation. In a nutshell, our main observation is that 'words seem to speak louder than numbers'. That said, we also find that 'a picture is worth a thousand words'. Looking across the different types of communication in our experiments, simple verbal and visual information seem to be most powerful in affecting household inflation expectations. We thus conclude that when it comes to communicating about the inflation outlook, central bankers should KISS, i.e. 'keep it sophisticatedly simple'.

3.3 Additional results

Given the large heterogeneity usually observed in household expectations data, it is instructive to consider treatment effects for subgroups of the population. It is also informative to consider other moments of the distribution. In this section, we summarize these results and provide the full description in Appendix A.

Heterogeneity of treatment effects across socio-demographic groups Previous studies have highlighted substantial heterogeneity of inflation expectations across socio-demographic groups, but also in how different groups of households respond to information. Table 7 provides the results of regression (1) for different socio-demographic constituencies. The coefficients labeled *East Germany pre 1989* show that individuals who lived in the German Democratic Republic on average have about 40-50 basis points higher inflation expectations at short and intermediate forecast horizons. The coefficients on interaction terms with the East Germany dummy variable are almost all insignificant, suggesting that East Germans do not generally process information about the inflation outlook differently. A notable exception is the treatment 'Schnabel'. The statistically significant negative 73 basis points coefficients on the corresponding interaction terms at the 1Y and the 2-3Y horizons show that the reassuring communication style by ECB Executive Board member Isabel Schnabel appears to resonate particularly well with East German survey participants.

As shown in Table 6, this treatment also exerts stronger effects on female respondents. A few other differences are worthwhile noting with respect to gender differences in our survey. First,

consistent with e.g. D'Acunto et al. (2021), women on average have slightly higher prior inflation expectations. Second, female participants respond more strongly than men to visual information provided in the form of a chart. Finally, the information about the higher expected path of inflation provided by Bundesbank President Nagel leads women to revise their inflation expectations upwards substantially more strongly than men.

We also see interesting differences with respect to education, summarized in Table 8. First, participants with a college degree have significantly lower inflation expectations. That said, the provided information about the inflation outlook often effects individuals with and without college education in opposing ways. The coefficients on most treatments tend to be statistically significantly negative for households with educational status lower than college degree while they are often statistically significantly positive for individuals with a college degree. This suggests that the provided information about the inflation outlook is more effective in lowering inflation expectations for less educated households.

As a last exercise, we analyze differences of the treatment effects across individuals with varying degrees of trust in the central bank. Specifically, we rely on a question that asks participants to rate their trust in the ECB to achieve price stability in the medium-run on a scale from zero (no trust at all) to ten.

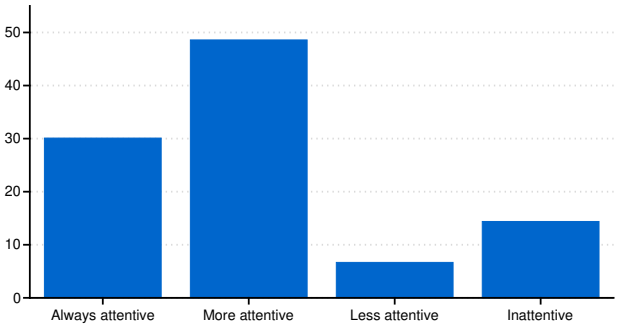
Figure 6 overlays histograms of reported trust in March and October 2022. While they are similarly distributed around the central tendency at both points in time, the distribution shifted a bit to the left from March to October 2022. This is likely due to the fact that inflation and inflation expectations had moved further away from the ECB's target of 2% during that period. To distinguish between individuals with low and high trust in the ECB, we separately estimate Equation (1) for the bottom and top quartile of the trust distribution.

The results are reported in Table 9. In both survey waves, we find that individuals with low trust have considerably higher inflation expectations than participants with high trust. The differences account for as much as 1.5 percentage points at the 2-3Y horizon. Interestingly, however, differences in the prior level of trust do not materially affect the way individuals update their inflation expectations in response to information about the inflation outlook. The same treatments are associated with significant revisions of inflation expectations across both groups of households, and with comparable magnitudes. One exception is the numerical 'forecast' treatment in the March survey, which resulted in substantially larger and statistically significant downward revisions for low-trust individuals, but did not move the expectations of high-trust respondents.

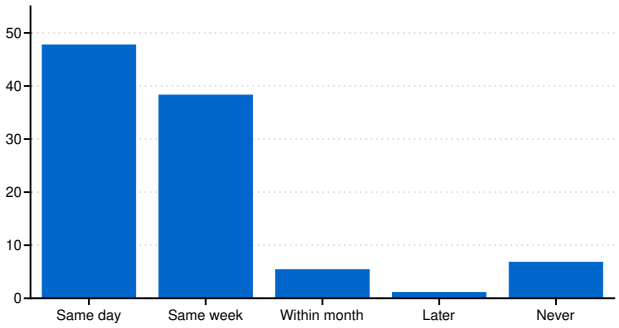
Treatment Effects on Inflation Uncertainty Information about central bank projections and policies may not only affect the first moment of household expectations, but also the uncertainty around those forecasts. To assess whether the treatments in our analysis have such effects, we use individual inflation uncertainty as measured by the standard deviation of the individual probabilistic responses as a dependent variable in regressions in the spirit of Equation (1). The results for the October wave are provided in Table 10 in Appendix A. They show that individ-

Figure 4: Attentiveness towards inflation developments (left panel) and informedness about monetary policy decisions (right panel) — Wave 34 October 2022

(a) 'Has your interest in inflation developments changed in recent weeks?'



(b) 'When do you become aware of monetary policy decisions or other announcements by the ECB?'



Notes: Left panel: 30% answer 'No, I always pay close attention to inflation developments.', 49% answer 'Yes, I pay more attention to inflation developments than before.', 7% answer 'Yes, but I pay less attention to inflation developments than before.', 14% answer 'No, I pay little attention to inflation developments.'. Right panel: 48% of respondents answer 'On the day of the announcement', 38% answer 'Within one week of the announcement', 5% answer 'Within one month of the announcement', 1% answers 'More than one month after the announcement', and 7% answer 'Never'.

ual inflation uncertainty has effectively been reduced by ECB communication about the inflation outlook, with the effects being statistically significant only for the short term, however.

4 Attention and belief updating

In this section, we study how much households update their beliefs when confronted with central bank information about the inflation outlook. We start by analyzing the attention that households pay to inflationary developments as well as their reported sources of information in Section 4.1. We formally assess the degree of updating when they receive pertinent information in Section 4.2.

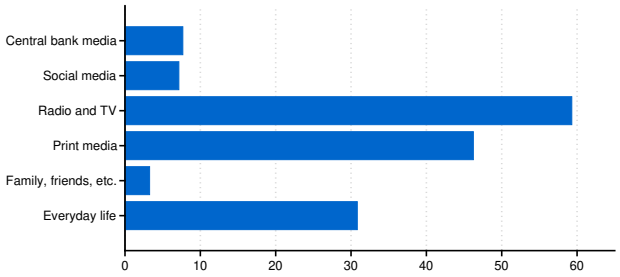
4.1 Attention to inflation and monetary policy

A key element in the expectation formation process is the information that economic agents have access to. In times of unusually high inflation, households might be more attentive to inflationary developments and thus update their expectations more often to incoming data (see, e.g., Reis (2006), Ehrmann (2006), or Maćkowiak and Wiederholt (2009)). It is thus instructive to assess whether households adapted their information acquisition process in the recent high-inflation environment. We study this by adding several questions to the October 2022 questionnaire with the aim to measure individuals' awareness of and exposure to central bank information and the duration of information dissemination (Roth et al., 2023). The exact wording of the questions, which were asked outside of the RCT, is provided in Table 13 in Appendix A.

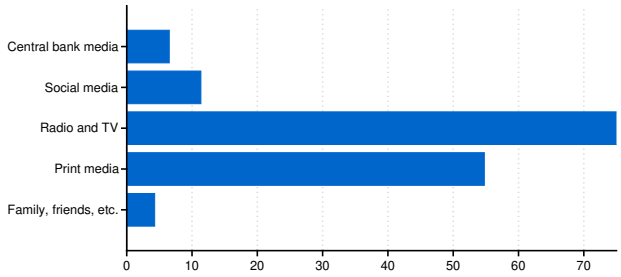
The left panel of Figure 4 shows that almost half of the participants report that they were paying more attention to inflationary developments in recent weeks. Another 30% respond that

Figure 5: Media use to learn about inflation developments (left) and central bank announcements (right) — Wave 34 October 2022

(a) 'Where do you mainly find information about inflation developments?'



(b) 'Where do you mainly find information about the ECB's monetary policy decisions?'



Notes: Left panel: 31% answer 'In my everyday life, e.g. when shopping', 3% answer 'Family, friends and acquaintances', 46% answer 'Daily newspapers, trade periodicals, etc.', 59% answer 'Radio, TV', 7% answer 'Social media, e.g. Twitter, Instagram, LinkedIn, Facebook, internet blogs and forums, etc.', 8% answer 'Information published by central banks such as the Deutsche Bundesbank or the ECB, e.g. written reports, web pages, etc.'. Right panel: 4% answer 'Family, friends and acquaintances', 55% answer 'Daily newspapers, trade periodicals, etc.', 76% answer 'Radio, TV', 11% answer 'Social media, e.g. Twitter, Instagram, LinkedIn, Facebook, internet blogs and forums, etc.', 7% answer 'Information published by central banks such as the Deutsche Bundesbank or the ECB, e.g. written reports, web pages, etc.'. Respondents could choose up to two sources of information, but not rank the answer options. Therefore and due to rounding, figures in the bar plots do not sum up to one hundred.

they are always attentive. Hence, taken together, the vast majority of households reportedly is well informed about inflation dynamics. At the same time, the right panel of Figure 4 shows that a large fraction of participants in the October survey report being well-informed about monetary policy decisions by the ECB and usually become aware of these on the same day or within the same week. Overall, the data suggest a high degree of attentiveness towards inflation and monetary policy in the high-inflation environment of October 2022.

We further surveyed participants about their sources of information. The left panel of Figure 5 shows that television is the main information source for learning about inflationary developments (mentioned by about 60% of respondents). This is also the case for information about the ECB's monetary policy decisions, as shown in the right panel of Figure 5. More than three-quarters of households inform themselves about central bank decisions via radio and TV, followed by print media (55%) and social media (11%). At the same time, Figure 5 shows that the central bank's own media offerings are not utilized much by households.

4.2 Central bank communication and belief updating

We next assess how households weigh the information implied in central bank communication by adopting a Bayesian learning perspective as in Coibion et al. (2018). Estimating how households evaluate central bank information against their prior beliefs, requires a full set of a-priori and a-posteriori expectations. As described in Section 2.1, we collect these in a within-subject design for the medium-term (2-3Y), corresponding to the ECB's policy horizon. Equation (2) formalizes this notion of Bayesian updating:

$$\text{posterior beliefs} = (1 - \text{G}) \times \text{prior beliefs} + \text{G} \times \text{central bank communication}. \tag{2}$$

According to Equation 2, the posterior beliefs of any household (we drop the subscript i for simplicity) are a weighted average of prior beliefs and the signals individuals receive. The weight, also referred to as 'gain', G, measures the degree to which households rely on the signal rather than their prior when forming their posterior expectation. In our experiment, the signals are pieces of central bank communication randomly assigned to different groups of respondents. An estimated gain larger than zero implies that households make use of the information when forming their beliefs. In contrast, a completely uninformative or incredible signal will give rise to a zero gain, and prior and posterior expectation will coincide. Following Coibion et al. (2022), one can estimate the relationship in Equation (2) by regressing households' posterior expectations on their prior, a dummy indicating the respective treatment s, and an interaction term of the treatment indicator and the prior expectation.

$$\text{mean}_i^{posterior} = \beta \cdot \text{mean}_i^{prior} + \sum_s^S \delta_s \cdot d_{s,i} + \sum_s^S \gamma_s \cdot d_{s,i} \cdot \text{mean}_i^{prior} + \varepsilon_i. \tag{3}$$

Because we employ the same question format to elicit expectations before and after treatment, we cannot include the control group in these regressions and omit the term $\beta \cdot \text{mean}_i^{prior}$. Hence, in our setup, the posterior beliefs of household i subject to an information treatment s, evolve according to

$$\text{mean}_i^{posterior} = \hat{\delta} + \hat{\gamma} \cdot \text{mean}_i^{prior} + \varepsilon_i. \tag{4}$$

The estimate $\hat{\gamma}$ then corresponds to $\overline{(1 - \text{G})}$ in Equation 2 and represents the weight an individual receiving treatment s puts on their prior inflation expectations. The weight a household puts on the central bank signal G cannot be identified directly, but can only be considered as a residual quantity. We thus focus mainly on the estimates $\hat{\gamma}$ in our discussion below. The estimated parameter $\hat{\delta}$ should only be viewed as a qualitative indicator of how much weight a specific treatment receives when households form their posterior expectations.

Table 5 provides the results for estimating Equation (4) on data from the October 2022 survey wave.[14] The first column shows the results for all respondents, the following three columns provide the results for subgroups of individuals regarding their attention to inflation and monetary policy. The results show that central bank communication is effective for all groups of participants as the estimates $\hat{\gamma}$ are all statistically different from zero. Moreover, we can also reject the null that $\gamma = 1$ in all cases. This implies that survey participants partially rely on the provided information when updating their expectations. As γ reflects the weight $1 - G$ that individuals attach to prior information, a smaller $\hat{\gamma}$ implies a greater reliance on the provided information. Comparing the

[14] The corresponding results for the March 2022 survey wave are shown in Table 12 in Appendix A.

Table 5: Learning about the medium term (2-3Y) — October 2022

	all participants	high attention	low attention	quickly informed
	treatment category 'numerical'			
	'forecast'			
$\hat{\delta}$	1.81***	1.66***	2.22***	1.06***
	(0.11)	(0.11)	(0.21)	(0.17)
$\hat{\gamma}$	0.68***	0.69***	0.64***	0.78***
	(0.02)	(0.02)	(0.03)	(0.02)
	'forecast ext.'			
$\hat{\delta}$	1.57***	1.37***	1.86***	1.29***
	(0.12)	(0.17)	(0.21)	(0.19)
$\hat{\gamma}$	0.73***	0.72***	0.79***	0.73***
	(0.02)	(0.03)	(0.03)	(0.03)
	treatment category 'visual'			
	'table'			
$\hat{\delta}$	1.11***	0.74***	2.12***	1.20***
	(0.10)	(0.11)	(0.18)	(0.18)
$\hat{\gamma}$	0.82***	0.86***	0.69***	0.75***
	(0.02)	(0.01)	(0.04)	(0.03)
	'graph'			
$\hat{\delta}$	1.60***	1.27***	2.32***	0.97***
	(0.16)	(0.23)	(0.25)	(0.22)
$\hat{\gamma}$	0.67***	0.71***	0.59***	0.74***
	(0.03)	(0.05)	(0.05)	(0.04)
	treatment category 'verbal'			
	'Schnabel'			
$\hat{\delta}$	1.30***	0.80***	2.33***	1.16***
	(0.10)	(0.11)	(0.24)	(0.15)
$\hat{\gamma}$	0.80***	0.86***	0.67***	0.79***
	(0.02)	(0.01)	(0.05)	(0.03)
	'Nagel'			
$\hat{\delta}$	2.06***	1.78***	2.82***	1.57***
	(0.12)	(0.16)	(0.24)	(0.19)
$\hat{\gamma}$	0.68***	0.71***	0.58***	0.72***
	(0.02)	(0.02)	(0.04)	(0.03)
	'Nagel ext.'			
$\hat{\delta}$	1.63***	1.57***	1.71***	1.52***
	(0.10)	(0.12)	(0.18)	(0.17)
$\hat{\gamma}$	0.76***	0.74***	0.80***	0.74***
	(0.02)	(0.02)	(0.03)	(0.03)
Observations	4.375	3.486	888	2.096

Notes: Standard errors reported in parentheses. Asterisks (***,** ,*) denote statistically significant differences from zero at the 1%, 5%, and 10%-level, respectively.

estimated coefficients across treatments for all participants, we see that the visualization with a graph has the strongest impact in shifting posterior expectations away from the prior, consistent with our results in the previous section.

In the second column of Table 5, labeled 'high attention', we present estimates based only on responses from participants who replied that they pay more or at least the same degree of attention to current inflation developments compared to before. This group includes roughly

two-thirds of the sample. The third column of Table 5, labeled 'low attention', is estimated on data from participants that replied they pay less attention to current inflation developments or none at all. A comparison of estimation results for these two groups shows that the information treatments often more strongly affect households with low reported attentiveness to inflation and monetary policy. For example, the information provision via the 'graph' treatment has a value of $\hat{\gamma} = 0.59$, which is more than 20 basis points lower than the corresponding estimate for the more attentive households. Hence, with certain types of communication, central banks can exert quite a strong impact on the expectation formation of otherwise less attentive households.

The last column of Table 5 shows results for households who consider themselves to be 'quickly informed' about central bank news. That is, they self-reportedly learn about new central bank information on the day of its publication. While the learning effects are sizable and statistically significant, analogous to the highly attentive households, this group is less strongly influenced by central bank communication compared to low-attention households.

The effects of information provision on expected inflation are illustrated using scatter plots in Figures 7 and 8 in Appendix A.3. In both figures, prior expectations (x-axis) are plotted against posterior expectations (y-axis). Values on the 45-degree line imply households' priors equal their posteriors. The grey-colored regression lines attaining slopes of less than unity suggest that on average households adjust their beliefs downwards when receiving information about the inflation outlook.

In sum, the evidence in this section implies that $\overline{(1-\mathrm{G})}$ is smaller than one in our two survey waves. Hence, households rely on central bank communication as an important source of information when updating their beliefs. These findings complement those of Cavallo et al. (2017) and Weber et al. (2025), showing that households respond more strongly to central bank communication when their attentiveness is low, even in an environment of elevated inflation.

5 Conclusion

We report novel survey evidence on the responsiveness of households' expected inflation to central bank communication using experimental data. Specifically, we conduct randomized controlled trials to causally identify the effects of different types of genuine ECB information about the inflation outlook on households' inflation expectations. We document that ECB communication about the inflation outlook significantly shifted households' elevated inflation expectations back towards the ECB's inflation target in a period of high and volatile inflation.

While the ECB's communication lowers expected inflation across the board, our evidence suggests that certain forms of information provision are more powerful than others with regards to expectations management. Specifically, reassuring verbal communication that does not provide much quantitative information generates significantly larger treatment effects than number-heavy verbal communication formats. While these observations are valid in particular for short-term

expected inflation, graphical illustrations of the inflation outlook are found to effectively lower expected inflation also at longer horizons. We further show that households make use of the provided information when updating their expectations, effectively reducing the weight of their prior beliefs of above-target inflation.

Our results provide a statistical underpinning to widely used idioms. In essence, we find that 'words speak louder than numbers'. We also observe that a 'picture is worth a thousand words'. If central bank communication aims at maximizing its outreach to a broad and diverse audience, easy-to-process graphs, and positively-framed, non-technical and relatable verbal explanations emerge as effective vehicles to doing so. Therefore, we suggest that central banks should follow the KISS principle when communicating with the general public and 'keep it sophisticatedly simple'.

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A Additional Results

A.1 Heterogeneity of treatment effects

Table 6: Heterogeneity of treatment effects: men vs. women

	1Y	2-3Y	5-10Y
β_0 (control group)	5.85***	5.13***	3.85***
	(0.11)	(0.21)	(0.15)
'forecast'	−0.42***	−0.32*	−0.15
	(0.10)	(0.16)	(0.12)
'forecast ext.'	−0.61***	−0.31**	−0.05
	(0.12)	(0.15)	(0.11)
'table'	−0.59***	−0.35**	−0.18*
	(0.11)	(0.16)	(0.11)
'graph'	−0.49***	−0.55***	−0.31***
	(0.10)	(0.15)	(0.11)
'Nagel'	−0.24***	−0.03	0.02
	(0.08)	(0.15)	(0.10)
'Nagel ext.'	−0.20**	−0.12	−0.01
	(0.09)	(0.15)	(0.11)
'Schnabel'	−0.39***	−0.18	−0.05
	(0.11)	(0.20)	(0.15)
female	−0.03	0.17	0.35***
	(0.11)	(0.15)	(0.12)
'forecast' x female	0.23	0.13	0.09
	(0.15)	(0.19)	(0.16)
'forecast ext.' x female	0.03	0.01	−0.01
	(0.17)	(0.19)	(0.16)
'table' x female	0.25*	−0.14	−0.10
	(0.15)	(0.18)	(0.15)
'graph' x female	−0.42***	−0.21	−0.34**
	(0.15)	(0.17)	(0.14)
'Nagel' x female	0.52***	0.37**	0.27*
	(0.14)	(0.17)	(0.16)
'Nagel ext.' x female	−0.12	0.06	0.14
	(0.15)	(0.19)	(0.16)
'Schnabel' x female	−0.56***	−0.38*	−0.29
	(0.17)	(0.23)	(0.18)
Observations	5,060	5,069	5,056

Notes: These results are based on the BOP-HH survey wave 34 conducted in October 2022. Standard errors reported in parentheses. Asterisks (***,** ,*) denote statistically significant differences at the 1,5, and 10% levels, respectively. All observations are weighted using survey weights.

Gender Table 6 shows a split-sample analysis for men and women. Men are more responsive to numerical information and visuals while women respond most strongly to verbal communication, particularly the excerpt from Isabel Schnabels' speech. Women also raise their inflation expectations particularly strongly after seeing the statement by Bundesbank President Nagel.

Table 7: Heterogeneity of treatment effects: East vs. West Germans

	1Y	2-3Y	5-10Y
β_0 (control group)	6.06***	5.35***	4.34***
	(0.15)	(0.17)	(0.18)
	treatment category 'numerical'		
'forecast'	−0.29***	−0.23**	−0.21*
	(0.11)	(0.11)	(0.11)
'forecast ext.'	−0.50***	−0.24*	−0.20*
	(0.12)	(0.12)	(0.11)
	treatment category 'visual'		
'table'	−0.33***	−0.32***	−0.30***
	(0.12)	(0.11)	(0.11)
'graph'	−0.62***	−0.58***	−0.60***
	(0.11)	(0.09)	(0.10)
	treatment category 'verbal'		
'Nagel'	0.09	0.19*	0.02
	(0.11)	(0.10)	(0.12)
'Nagel ext.'	−0.19	−0.02	−0.11
	(0.12)	(0.12)	(0.12)
'Schnabel'	−0.65***	−0.19	−0.23*
	(0.11)	(0.13)	(0.12)
East Germany pre 1989	0.41**	0.49**	0.22
	(0.18)	(0.19)	(0.20)
'forecast' x East	0.20	−0.13	−0.02
	(0.23)	(0.62)	(0.38)
'forecast ext.' x East	0.13	0.13	0.05
	(0.25)	(0.28)	(0.29)
table' x East	−0.21	0.08	0.11
	(0.24)	(0.41)	(0.47)
'graph' x East	0.05	0.02	0.18
	(0.26)	(0.30)	(0.28)
'Nagel' x East	−0.16	−0.09	0.33
	(0.22)	(0.22)	(0.25)
'Nagel ext.' x East	−0.04	0.09	0.59*
	(0.24)	(0.29)	(0.31)
'Schnabel' x East	−0.73**	−0.73**	−0.36
	(0.36)	(0.34)	(0.33)
Observations	4,756	4,767	4,756

Notes: These results are based on the BOP-HH survey wave 34 conducted in October 2022. Standard errors reported in parentheses. Asterisks (***,** ,*) denote statistically significant differences at the 1%, 5%, and 10%-levels, respectively. All observations are weighted using survey weights.

East and West Table 7 repeats our baseline analysis with an interaction term for participants who lived in East Germany in 1989.[15] In line with the previous literature, the positive sign on the 'East Germany pre-1989' dummy shows that survey participants from East Germany have higher unconditional inflation expectations than their West German peers. That said, the interaction terms are mostly insignificant, indicating that participants from East and West Germany generally respond similarly to the information treatments. The only exception is the treatment 'Schnabel' to which East German individuals respond more than twice as strongly compared to West German households, with a highly statistically significant 1.3 percentage points reduction in expected inflation for the short and medium term.

[15]This does not necessarily imply that they still live in one of the East German states. That said, in the October 2022 wave, there were about 800 participants from East Germany and about 3800 from West Germany, largely reflecting the relative population of East and West Germany today.

Table 8: Heterogeneity of treatment effects: college degree vs. no college degree

	1Y	2-3Y	5-10Y
β_0 (control group)	5.87***	5.26***	3.91***
	(0.11)	(0.18)	(0.14)
'forecast'	−0.42***	−0.49***	−0.27***
	(0.08)	(0.11)	(0.09)
'forecast ext'	−0.63***	−0.41***	−0.06
	(0.09)	(0.11)	(0.09)
'table'	−0.46***	−0.52***	−0.26***
	(0.08)	(0.11)	(0.09)
'graph'	−0.68***	−0.83***	−0.56***
	(0.08)	(0.10)	(0.08)
'Nagel'	0.002	0.04	0.08
	(0.07)	(0.10)	(0.09)
'Nagel ext.'	−0.18**	−0.13	0.03
	(0.08)	(0.11)	(0.10)
'Schnabel'	−0.79***	−0.53***	−0.28***
	(0.10)	(0.13)	(0.10)
college	−0.11	−0.63***	−0.45***
	(0.13)	(0.12)	(0.13)
'forecast' x college	0.44***	0.86***	0.67***
	(0.17)	(0.21)	(0.20)
'forecast ext.' x college	0.09	0.31	−0.003
	(0.19)	(0.19)	(0.16)
'table' x college	0.03	0.31*	0.09
	(0.19)	(0.17)	(0.16)
'graph' x college	−0.10	0.62***	0.29*
	(0.17)	(0.15)	(0.15)
'Nagel' x college	0.04	0.33*	0.20
	(0.18)	(0.18)	(0.17)
'Nagel ext.' x college	−0.29	0.07	0.03
	(0.18)	(0.16)	(0.15)
'Schnabel' x college	0.45**	0.45**	0.25
	(0.20)	(0.19)	(0.17)
Observations	5,060	5,069	5,056

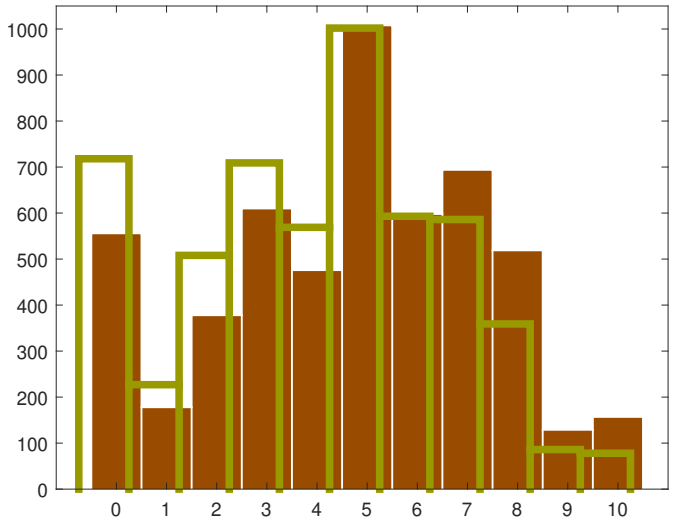
Notes: These results are based on the BOP-HH survey wave 34 conducted in October 2022. Sample contains individuals that reported a trust level greater or equal the 0.9 quartile of the trust distribution. Standard errors reported in parentheses. Asterisks (***,** ,*) denote statistically significant differences at the 1,5, and 10% levels, respectively. All observations are weighted using survey weights.

Education Table 8 explores heterogeneity in the effects of central bank communication with respect to respondents' reported highest education degree (college versus no college). Respondents without a college degree report considerably higher expected inflation, especially over longer horizons. Regarding their response to information about the inflation outlook, visualization via a graph has the largest overall impact on expected inflation across horizons for people without a college degree. Interestingly, college graduates respond *less* to numerical information such as ECB projections. A possible explanation is that the ECB forecasts are closer to their reported prior expected inflation and as such contain less new information for these respondents.

Trust in the Central Bank The final degree of heterogeneity we consider is the prior trust that households place in the ECB's ability to achieve price stability. Surveying households about their trust level is not part of the core questionnaire,but we included such a question in both survey waves prior to the information treatments. Figure 6 superimposes the trust distributions at both points in time. The scale ranges from zero, indicating no trust in the ECB's ability to achieve price stability, to ten, i.e. full trust in this ability. The average (median) trust in March 2022 was at 4.72 (5). Trust values declined somewhat after March, reaching an average (median) of 4.2 (4) in October 2022. We use the 25% and the 75% quantiles of the respective trust distributions to split our sample of respondents into participants with low and high trust, respectively. We then estimate Equation (1) on these subsamples. The results for March and October 2022 are shown in the top and bottom panel of Table 9, respectively.

Two observations are worth noting. First, in both survey waves, individuals with low trust have substantially higher inflation expectations than respondents with high trust, the differences reaching as much as 1.8 percentage points at the one-year horizon. Second, differences in the prior level of trust do not seem to materially affect the way they process information about the inflation outlook. For both survey waves, the same set of treatments generally lead to significant revisions of inflation expectations across both groups of households, and with similar magnitudes. A notable exception is the numerical 'forecast' treatment in the March survey, which led to substantially larger and statistically significant downward revisions for low-trust individuals, but did not affect the expectations of high-trust households.

Figure 6: Households' trust in the ECB's ability to achieve price stability



Notes: Solid orange bars correspond to Wave 27 March 2022 trust values, Yellow bar frames correspond to Wave 34 October 2022 trust values. The response scale (X axis) runs from zero (no trust in the ECB's ability to achieve price stability) to ten (full in the ECB's ability). The average trust level in March 2022 is at 4.72, with median trust at 5. With the trust distribution yielding tn the right, the average trust level in October has decreased to 4.2, with median trust standing at 4. The Y axis plots the number of respondents.

Table 9: Average treatment effects for mean expected inflation by trust in the ECB

	March 2022					
	Low trust			**High trust**		
	$1Y$	$2-3Y$	$5-10Y$	$1Y$	$2-3Y$	$5-10Y$
	Estimation w/ all treatments pooled					
β_0^{pooled}	4.96***	4.98***	4.42***	3.84***	3.51***	3.10***
	(0.18)	(0.20)	(0.20)	(0.20)	(0.18)	(0.18)
β_s^{pooled}	-0.19**	-0.28***	-0.15	-0.24***	-0.16**	-0.14*
	(0.09)	(0.10)	(0.10)	(0.09)	(0.08)	(0.08)
	Estimation w/ treatment dummies					
β_0 (control group)	4.98***	4.98***	4.44***	3.90***	3.54***	3.15***
	(0.18)	(0.20)	(0.20)	(0.20)	(0.18)	(0.18)
	treatment category: 'numerical'					
'forecast'	-0.34***	-0.49***	-0.28**	0.00	-0.05	-0.11
	(0.12)	(0.13)	(0.13)	(0.12)	(0.11)	(0.11)
'forecast ext.'	0.05	-0.15	-0.10	-0.12	-0.13	-0.01
	(0.12)	(0.14)	(0.13)	(0.12)	(0.10)	(0.11)
	treatment category: 'verbal'					
'Lane'	-0.35***	-0.38***	-0.27**	-0.44***	-0.25**	-0.25**
	(0.12)	(0.14)	(0.14)	(0.12)	(0.11)	(0.11)
'Lane ext.'	-0.26**	-0.28**	-0.07	-0.47***	-0.29***	-0.28***
	(0.12)	(0.14)	(0.13)	(0.11)	(0.10)	(0.10)
'Nagel'	-0.05	-0.13	-0.03	-0.10	-0.02	0.00
	(0.12)	(0.13)	(0.13)	(0.12)	(0.11)	(0.11)
Observations	1,499	1,489	1,480	1,309	1,306	1,305
	October 2022					
	Estimation w/ all treatments pooled					
β_0^{pooled}	6.30***	5.71***	4.78***	5.30***	4.53***	4.17***
	(0.33)	(0.35)	(0.41)	(0.38)	(0.31)	(0.27)
β_s^{pooled}	-0.21	-0.05	-0.15	-0.36**	-0.11	-0.12
	(0.16)	(0.17)	(0.20)	(0.16)	(0.13)	(0.12)
	Estimation w/ treatment dummies					
β_0 (control group)	6.24***	5.58***	4.68***	5.24***	4.56***	4.14***
	(0.34)	(0.36)	(0.41)	(0.37)	(0.31)	(0.27)
	treatment category 'numerical'					
'forecast'	-0.18	-0.05	-0.28	-0.17	-0.19	-0.18
	(0.21)	(0.22)	(0.25)	(0.21)	(0.18)	(0.16)
'forecast ext.'	-0.13	0.02	-0.04	-0.67***	-0.16	-0.14
	(0.22)	(0.23)	(0.27)	(0.20)	(0.17)	(0.15)
	treatment category 'visual'					
'table'	-0.18	-0.13	-0.16	-0.41*	-0.22	-0.26
	(0.22)	(0.23)	(0.26)	(0.22)	(0.18)	(0.16)
'graph'	-0.53**	-0.46**	-0.55**	-0.69***	-0.49***	-0.52***
	(0.21)	(0.23)	(0.26)	(0.21)	(0.17)	(0.15)
	treatment category 'verbal'					
'Schnabel'	-0.53**	-0.23	-0.46*	-0.82***	-0.28	-0.15
	(0.21)	(0.23)	(0.26)	(0.21)	(0.17)	(0.15)
'Nagel'	0.22	0.38*	0.29	0.20	0.31*	0.20
	(0.21)	(0.22)	(0.25)	(0.21)	(0.18)	(0.16)
'Nagel ext.'	-0.18	0.09	0.07	0.05	0.24	0.23
	(0.22)	(0.23)	(0.26)	(0.21)	(0.17)	(0.15)
Observations	1,266	1,268	1,262	1,482	1,487	1,483

Notes: Results in columns 2-4 are based on individuals that reported a trust level below or equal to the 25% quartile of the trust distribution, results in columns 5-7 are based on individuals that reported a trust level equal or above to the 75% quartile. Standard errors are reported in parentheses. Asterisks (***,** ,*) denote statistically significant differences at the 1,5, and 10% levels, respectively. All observations are weighted using survey weights.

Table 10: Average treatment effects on uncertainty — October 2022

	1Y	2-3Y	5-10Y
	Estimation w/ all treatments pooled		
β_0^{pooled}	1.26***	1.10***	1.08***
	(0.07)	(0.06)	(0.06)
β_s^{pooled}	−0.13***	−0.04	−0.01
	(0.03)	(0.03)	(0.03)
	Estimation w/ treatments dummies		
β_0 (control group)	1.27***	1.11***	1.09***
	(0.07)	(0.06)	(0.06)
	treatment category 'numerical'		
'forecast'	−0.16***	−0.07*	−0.03
	(0.04)	(0.04)	(0.04)
'forecast ext.'	−0.15***	−0.03	0.01
	(0.04)	(0.04)	(0.04)
	treatment category 'visual'		
'table'	−0.17***	−0.09**	−0.05
	(0.04)	(0.04)	(0.04)
'graph'	−0.14***	−0.07**	−0.05
	(0.04)	(0.04)	(0.04)
	treatment category 'verbal'		
'Schnabel'	−0.10**	0.01	0.03
	(0.04)	(0.04)	(0.04)
'Nagel'	−0.07*	0.01	0.02
	(0.04)	(0.04)	(0.04)
'Nagel ext.'	−0.11**	−0.03	0.00
	(0.04)	(0.04)	(0.04)
Observations	2,521	2,739	2,686

Notes: Standard errors reported in parentheses. Asterisks (***,** ,*) denote statistically significant differences at the 1%, 5%, and 10%-levels, respectively. All observations are weighted using survey weights.

A.2 Central bank communication and inflation uncertainty

Here, we analyze whether the different types of information provision of ECB communication can affect households' individual uncertainty about the inflation outlook. Theory suggests that households' spending behavior is directly related to their inflation expectations via real interest rates. Recent empirical evidence supports this theoretical link, see e.g. Armantier et al. (2021), Ryngaert (2022), (Andrade et al., 2023), Coibion et al. (2024).

We measure individual uncertainty about inflation using the standard deviation of respondents' individual probability distributions for expected inflation at the 2-3Y horizon. We focus on respondents who assign positive probabilities to three or more bins when reporting their inflation expectations. Table 10 provides the results for the October 2022 survey.

We find that uncertainty about the short run is moderately higher in the short compared to the medium and longer run. That said, the provided central bank communication significantly reduces participants' uncertainty about future inflation at the one-year horizon. While there are qualitative differences in the size of the treatment effects, we cannot establish a statistical significance of these differences between treatments.

A.3 Additional Tables and Figures

In this appendix, we provide additional Tables and Figures which are referenced throughout the main text.

Table 11: F-tests for differences in treatment effects — Wave 34 October 2022

		'forecast ext.'	'table'	'graph'	'Nagel'	'Nagel ext.'	'Schnabel'
1Y	'forecast'	0.22*	0.12	0.35***	-0.31***	-0.06	0.51***
2-3Y	'forecast'	-0.05	0.07	0.31***	-0.42***	-0.25**	0.05
5-10Y	'forecast'	-0.03	0.09	0.34***	-0.26***	-0.19**	0.06
1Y	'forecast ext.'		-0.10	0.13	-0.53***	-0.28**	0.29**
2-3Y	'forecast ext.'		0.12	0.36***	-0.37***	-0.20*	0.10
5-10Y	'forecast ext.'		0.12	0.37***	-0.23**	-0.16*	0.09
1Y	'table'			0.23**	-0.43***	-0.18	0.39***
2-3Y	'table'			0.24**	-0.49***	-0.32***	-0.02
5-10Y	'table'			0.25**	-0.35***	-0.28***	-0.03
1Y	'graph'				-0.66***	-0.41***	0.16
2-3Y	'graph'				-0.73***	-0.56***	-0.26**
5-10Y	'graph'				-0.60***	-0.53***	-0.28***
1Y	'Nagel'					0.25**	0.82***
2-3Y	'Nagel'					0.17	0.47***
5-10Y	'Nagel'					0.07	0.32***
1Y	'Nagel ext.'						0.57***
2-3Y	'Nagel ext.'						0.30***
5-10Y	'Nagel ext.'						0.25**

Notes: For each treatment, three rows corresponding to the expectation horizon 1Y, 2-3Y and 5-10Y, respectively, are shown. Figures represent the difference in expectations between the treatments depicted in the column and row name. The difference tested in the F-tests is defined as the 'row' variable minus the 'column' variable, for instance, treatment 'forecast' minus treatment 'forecast ext.'.

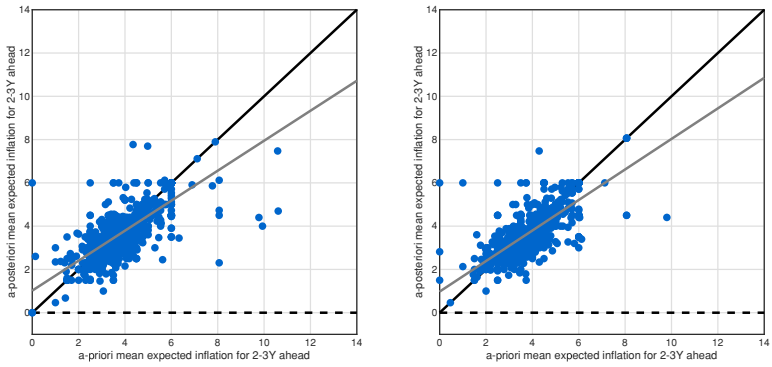
Table 12: Learning about the medium term (2-3Y) — March 2022

	all participants
	treatment category 'numerical'
	'forecast'
$\hat{\delta}$	1.02***
	(0.12)
$\hat{\gamma}$	0.64***
	(0.03)
	'forecast ext.'
$\hat{\delta}$	1.75***
	(0.12)
$\hat{\gamma}$	0.46***
	(0.03)
	treatment category 'verbal'
	'Lane'
$\hat{\delta}$	1.42***
	(0.10)
$\hat{\gamma}$	0.56***
	(0.03)
	'Lane ext.'
$\hat{\delta}$	1.17***
	(0.10)
$\hat{\gamma}$	0.62***
	(0.03)
	'Nagel'
$\hat{\delta}$	1.18***
	(0.12)
$\hat{\gamma}$	0.62***
	(0.03)
Observations	4,039

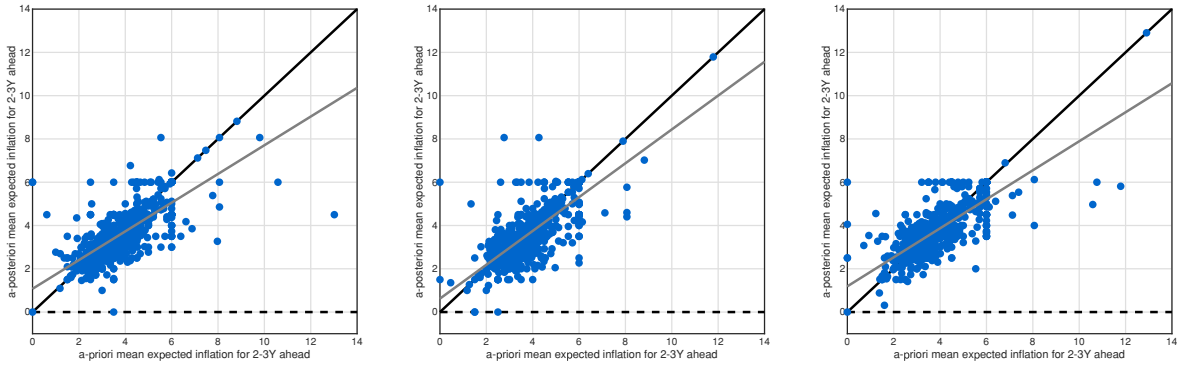
Notes: Standard errors reported in parentheses. Asterisks (***,**,*) denote statistically significant differences from zero at the 1%,5%, and 10%-level, respectively.

Figure 7: Updating of medium-term expected inflation by treatment group — Wave 27 March 2022

(a) 'forecast' (b) 'forecast ext.'

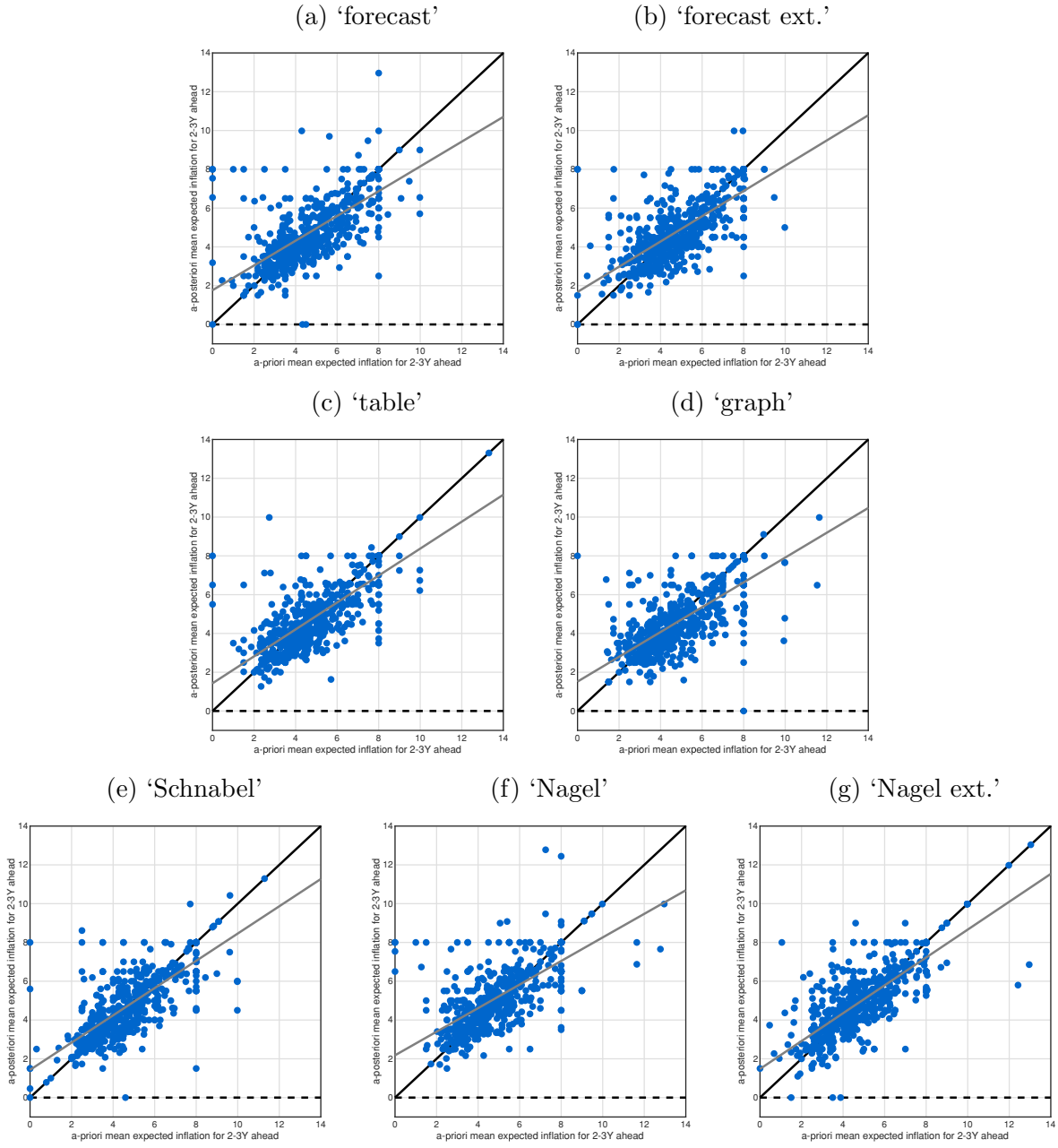


(c) 'Lane' (d) 'Lane ext.' (e) 'Nagel'



Notes: Blue dots represent prior expected inflation 2-3Y ahead (X axis) plotted against posterior expected inflation 2-3Y ahead (Y axis). A 45-degree line is plotted in solid black, a regression line is plotted in gray.

Figure 8: Updating of medium-term expected inflation by treatment group — Wave 34 October 2022



Notes: Blue dots represent prior expected inflation 2-3Y ahead (X axis) plotted against posterior expected inflation 2-3Y ahead (Y axis). A 45-degree line is plotted in solid black, a regression line is plotted in gray.

B Survey details

Table 13: Questions on inflation awareness and media — Wave 34 October 2022

inflmedia1	Has your interest in inflation developments changed in recent weeks? 1 No, I always pay close attention to inflation developments. 2 Yes, I pay more attention to inflation developments than before. 3 Yes, but I pay less attention to inflation developments than before. 4 No, I pay little attention to inflation developments.
inflmedia2	Where do you mainly find out information about inflation developments? (Note: Please select a maximum of two answers.) a In my everyday life, e.g. when shopping b Family, friends and acquaintances c Daily newspapers, trade periodicals, etc. d Radio, TV e Social media, e.g. Twitter, Instagram, LinkedIn, Facebook, internet blogs and forums, etc. f Information published by central banks such as the Deutsche Bundesbank or the ECB, e.g. written reports, web pages, etc.
inflmedia3	We would now like to take a closer look at the monetary policy decisions of the European Central Bank (ECB). When do you become aware of monetary policy decisions or other announcements by the ECB? 1 On the day of announcement 2 Within one week of announcement 3 Within one month of announcement 4 More than one month after announcement 5 Never
inflmedia4	Where do you mainly find out information about the ECB's monetary policy decisions? (Note: Please select a maximum of two answers.) a Family, friends and acquaintances b Daily newspapers, trade periodicals, etc. c Radio, TV d Social media, e.g. Twitter, Instagram, LinkedIn, Facebook, internet blogs and forums, etc. e Information published by central banks such as the Deutsche Bundesbank or the ECB, e.g. written reports, web pages, etc.

Notes: The above questions were asked outside the RCT. They are extracurricular to the survey as such, but were embedded in parts of the questionnaire were they are within context.