Imprecision and speaker identity: How persona-level information affects meaning resolution

December 23, 2020

1 Introduction

Linguistic signs can encode meaning on multiple levels. On the one hand, they are associated with semantic content, which allows speakers to describe the external world, as well as to express their internal feelings and mental states. On the other hand, they can evoke social meaning, a constellation of qualities and properties about the social identity of speakers – e.g., their demographics, personality, ideological orientation and relation to addressee (Ochs 1992; Eckert 2008; Podesva 2011 among others). Consider the modifier totally in English.

(1) I’m totally coming to the party.

On the semantic level, this expression signals the speaker’s complete commitment towards attending the party, as well as their emotive excitement about the event (Beltrama 2018b). On a social level, the same expression invokes a package of additional content. Specifically, a person using this modifier in such a context is likely to be perceived as relatively young, friendly, outgoing, not particularly articulate; and perhaps as associated with some kind of stereotypical social category of speaker, or persona – e.g., a Frat Boy or a surfer dude (Beltrama and Staum Casasanto 2017; Kiesling 1998).

While the semantic and social levels of meaning are widely acknowledged across different subfields of linguistics, they have, by-and-large, been investigated separately. Only more recently have linguists begun to explore how elements from these two domains effectively interact with one another. In particular, a growing body of work has shown that listeners can recruit fine-grained semantic and pragmatic properties of utterances to infer information about the social identity of their interlocutor (see Beltrama and Staum Casasanto 2017; Acton and Potts 2014; Acton 2019; Glass 2015; Karawani and Waldon 2017; Jeong 2019; see §2 for more discussion). These investigations constitute an important first step towards establishing a more comprehensive view of meaning in language – one in which the boundaries between semantic and social layers of content are less clear cut than previously thought, and elements from across these categories can be combined by interlocutors to convey and interpret information and constructs relative to their social identity, personality, and ideology (see Eckert 2019; Beltrama 2020 for more discussion).

In this paper, we aim to extend this line of research by exploring the interface between social and semantic dimensions of meaning from an angle that is complementary to the one adopted in previous work. Rather than asking what possible repercussions for social meaning fine-grained
aspects of semantic and pragmatic content can have, we ask how social meaning can impact specific aspects of the interpretation process at the semantic and pragmatic level. We tackle this issue through the lens of the phenomenon of pragmatic (im)precision – the amount of leeway that listeners have to compute in the interpretation of a numerical expression, such as those in (2) and (3).

(2) It’s 6 o’clock.

(3) The ticket costs $300.

An utterance of (2), for example, is generally acceptable and taken to be true if the actual time is a few minutes before or after 6; similarly, (3) can serve as an appropriate description of circumstances even where the actual ticket cost is, say, $298 or $302. Yet, determining the precise extent to which such divergences are tolerable in a given situation is not trivial; rather, listeners are required to compute the admissible amount of imprecision for interpreting an expression on a case-by-case basis via reasoning about a variety of contextual factors – e.g., the interlocutors’ goals, the communicative setting, what’s a stake in the context etc. (see §2.3 for further details).

Based on evidence from two sets of picture selection experiments, we show that the social persona embodied by the speaker in the speech context – operationalized in terms of the opposition between characters that are stereotypically nerdy vs. chill – crucially impacts the interpretation of numerical expressions. In particular, descriptions uttered by nerdy speakers, who are socially expected to speak more precisely, are taken to adhere to higher standards of precision than descriptions uttered by chill speakers, suggesting that social meaning can impact the resolution of semantic content. Importantly, we additionally find that this effect is modulated by the social identity of the experimental participant whose interpretations of the experimental stimuli we measure: overall, the impact of the persona stereotypes on adjusting precision thresholds is much greater (and, in two of our sub-experiments, exclusively present) for listeners who don’t personally identify with the social identity of the speaker. Taken together, these findings provide novel insights into the interplay of semantic-pragmatic and social content in communication, ultimately laying the groundwork for developing a new, more comprehensive perspective on the study of meaning in natural language.

The paper is divided as follows. §2 introduces our research questions in greater detail, presenting imprecision resolution as an ideal test case to illuminate these issues; §3-4 report on the two sets of experiments. §5 provides a general discussion. §6 concludes.

2 Imprecision, context-sensitivity and social meaning

2.1 Social meaning: an overview

Work in sociolinguistics has unveiled the intimate connection between language and the social world, showing that linguistic forms can serve as a powerful resource for speakers to construct their social identity, and for listeners to infer the social identity of their interlocutors. The social value of linguistic forms is typically referred to as social meaning, a term that builds on the idea that linguistic forms signal – or index\(^1\) – information about the speaker identity every time they

\(^1\)The term is grounded in Peirce (1955)’s categorization of signs, where an index represents a sign that is grounded not in convention, but in a co-occurrence between the sign and the object, such as causality, co-presence, or some
are deployed in interaction (Ochs 1992; Silverstein 2003; Eckert 2012; Podesva 2011). The scope of this category is admittedly broad, both in terms of the range of linguistic forms that can index social meanings, and the types of social information that can be conveyed. For example, the alveolar realization of (ING) – as in *goin’*, *fishing* etc. – can evoke social meanings that pertain to the demographic profile of language users (e.g., “working class”, Trudgill 1972; Southerner, Campbell-Kibler 2011); their social and personality traits (e.g., “friendly”, “laid-back”, Campbell-Kibler 2011); and their ideological orientation (e.g., “outdoorsy”, “religious”, “family-oriented”, Campbell-Kibler 2011). For the purposes of the current paper, we focus on three important properties of social meanings, all of which contribute to informing the research question that motivates our work.

First, social meanings are not atomic, but rather tend to assemble in larger, recognizable social constructs. In particular, individual linguistic forms, and the social meanings that they convey, often cluster together to index stereotypically salient types of speakers, normally referred to as personae (Irvine 2001; Agha 2005; Coupland 2007; Eckert 2000, 2008; Podesva 2011; D’Onofrio 2018; Gal and Irvine 2019). In a foundational study, for example, Eckert (2000) shows that students in a high school of a suburb of Detroit recruit a combination of linguistic features – including phonological variants of the late stages of the Northern Cities shift and negative concord – to construct an anti-institutional, city-oriented “Burnout” persona, crucially defined in opposition to the suburb- and school-oriented “Jock”. Other widely investigated personae in the sociolinguistic literature include, among many others, “Valley Girls” (D’Onofrio 2015), “Nerds” (Bucholtz 2001), “Frat Boys” (Kiesling 1998), and “caring doctors” (Podesva 2011), all of which have been shown to be conveyed and constructed via linguistic features that span different levels of the grammar, often in combination with non-linguistic signs (e.g., smoking, clothing etc.). Second, although they can undergo conventionalization to a certain degree (Agha 2003), social meanings remain fluid and perspective-dependent objects: they are constantly open to being re-evaluated depending on interlocutors’ own personal and ideological views, with the consequence that language users often differ in their interpretation of the social significance of speech forms. For example, the indexical association between -in’ and Southern speakers can be re-interpreted as indexing the speaker as unpretentious and easy-going or insincere and condescending (Campbell-Kibler 2007); and the use of demonstratives such as *this* and *that* can be taken as a sign of the speaker being down to earth and likable, or disingenuous and presumptuous – depending on both the identity of the speaker and the hearer (Acton 2014). As a result, the nature of this type of content can be seen as inherently intersubjective: social meanings do not merely reflect who the speaker is or is aiming to come across as; rather, they are the result of a more complex interpretation process, which is ultimately shaped by a listeners’ own affiliation and identification with the social categories embodied by the speaker.

Third, social meanings are central not only to the socio-cultural dimension of language, but also to the psychological one. In particular, a number of studies have recently shown that social meanings shape and affect language processing at different levels, highlighting an intimate relationship between social information and the cognitive mechanisms of language production and perception. This research has primarily focused on phenomena at the sound level – e.g., phonemic

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other form of spatio-temporal contiguity. Peirce’s original semiotic theory has been heavily relied upon to theorize the nature of the link between linguistic forms and social meanings; see Ochs (1992); Silverstein (2003); Eckert (2008); Gal and Irvine (2019) for further discussion.
categorization (Niedzielski 1999; Hay 2009; D’Onofrio 2015, 2018), accommodation and con-
vergence (Staum Casasanto 2008; Babel and Nichols 2014) – and, to a lesser extent, syntactic
processing (Campbell-Kibler 2010; Weatherholz et al. 2012; Squires 2013). An especially im-
portant take away from these endeavors is that cognitive processes of language production and
perception are affected by a wide range of levels of social information: these include macro-level
social categories such as the speaker location of origin (Niedzielski 1999), gender (Strand 1999),
and race (Staum Casasanto 2008); but also, crucially, persona-level information (see in particular
D’Onofrio work on the effect of the Valley Girl type on different domains of speech perception:
D’Onofrio 2015, 2018, 2019). These studies further contributed to expanding the methodological
toolkit relevant to the study of social meaning, highlighting experimental approaches as a viable
tool to enrich and complement insights from ethnographic research – on which most investigations
on social meaning, including the foundational ones discussed above, are traditionally based.

2.2 Semantic, pragmatic and social meanings: towards an integrated perspective

While investigations of meaning within semantics and pragmatics and the study of social mean-
ing have typically been taken to constitute independent domains of research, a recent line of work
has begun to question this strict separation, showing that social meanings can be conveyed by and
inferred from (often very subtle) semantic and pragmatic properties of linguistic expressions. A
paradigmatic example is that of Acton and Potts (2014)’s analysis of the social meaning of demon-
stratives such as this and that, whose social meaning of solidarity and reciprocal affiliation between
the interlocutors can be derived from the core semantics of these expressions – and specifically in
the presumption that the addressee must be able to access the referent of the embedded noun phrase
by considering the speaker’s relation to entities in the discourse context. Similar inferential patterns
from semantic/pragmatic features to social meanings have been linked to a variety of phenomena
and expressions, including intensifiers like totally (Beltrama and Staum Casasanto 2017), deter-
miners (Acton 2019), modal auxiliaries like need to and may/might (Glass 2015; Karawani and
Waldon 2017), and particular types of speech acts (e.g., rising declaratives, Jeong 2019). Build-
ing on these results, as well as on other findings from the literature in social meaning, it’s been
further suggested that the linguistic signaling and uptake of social meaning can be captured via
frameworks similar to those used to formalize pragmatic inferences – including models based on
maxims-based reasoning (Acton 2014, 2019) or couched in game-theoretic approaches (Burnett
2017, 2019; see Beltrama 2020 for an overview of this work).

Looking at the broader picture, these findings show that it is possible for social meanings to
be linked in a principled way to the semantic and pragmatic aspects of linguistic expressions and
utterances, both empirically and formally, suggesting that at least certain aspects of these layers
are more closely related to one another than typically thought. In light of these considerations, two
questions arise as important for expanding research on these issues. First, just like social mean-
ing can be inferred or sometimes even derived from semantic and pragmatic features, does social
meaning conversely impact the processes at play in interpreting linguistic expressions? Second,
how is the effect of social information on meaning comprehension modulated by the comprehen-
der’s own identity – as well as their perspective on evaluating the speaker’s identity? Addressing
these issues would allow us to establish if, and to what extent, the interplay between social and
semantic meaning is indeed bi-directional – that is, if interlocutors, besides recruiting the semantic
and pragmatic properties of linguistic forms to infer social meanings, can conversely recruit so-
cial information to navigate the interpretation of semantic and pragmatic content. While providing a novel perspective to investigate the interaction between the semantic and social dimensions of meaning, shedding light on these issues would also allow us to better understand how social information affects language processing, expanding the empirical basis of this line of work beyond phenomena related to phonetic, phonological, and syntactic processing.

As mentioned in the introduction, we investigate these issues through the lens of pragmatic (im)precision, a phenomenon that emerges as an ideal test bed, due to its inherently indeterminate, context-sensitive nature and its demonstrated ability to be perceived as a salient index of social meaning. We now turn to discuss these two aspects in greater detail.

2.3 Imprecision and indeterminacy

Many linguistic expressions have effectively indeterminate meanings: their ultimate interpretation cannot be computed solely on the basis of their literal content, but rather depends on the comprehender integrating this content with information drawn from the broader communicative context – e.g., expectations about communicative principles (Grice 1975; Horn 1984; Levinson 2000), discourse structure (Roberts 2012), or world knowledge (Frazier 1999). Numerical and quantity expressions provide a well-known instantiation of this phenomenon. Let us again consider the two examples from the introduction.

(4) It’s 6 o’clock.
(5) The ticket costs $300.

Although times or prices might be taken to denote specific and precise values, they are routinely used in a more liberal way – one that doesn’t fully adhere to their denotation. For instance, it’s perfectly possible to imagine someone uttering (4) when the time is in fact 5:57; or someone uttering (5) when the price is in fact $295: while in both cases the description would strictly speaking qualify as false, there’s a clear intuition that, in many contexts, these utterances would easily be taken to be felicitous and true, despite the slight misalignment of their precise literal meaning and the facts. In other words, comprehenders can tolerate a certain amount of deviation from the literal truth conditions in interpreting numerical expressions – a phenomenon known under the label of imprecision (Lewis 1979; Pinkal 1995; Lasersohn 1999; Syrett et al. 2009; Kennedy 2007; Burnett 2011; Solt 2014; Klecha 2014; Aparicio 2017). The possibility of using numerical expressions imprecisely crucially highlights a space of indeterminacy around the actual interpretation of these forms, which comprehenders may have to resolve in a given situation: the expression “3 o’clock” can be effectively assigned a variety of different possible meanings – e.g., the exact time of 3:00, the interval comprised between 2:59 and 3:01, or an even larger interval comprised between 2:55 and 3:05 – forcing the comprehender to choose one interpretation amongst these depending on the circumstances.

The indeterminacy described above raises intriguing issues for the study of meaning. To begin with, it poses the challenge of developing a theory of meaning that successfully reconciles the possibility of speaking truthfully with the act of systematically deviating from linguistic expressions’ truth conditions – an issue that has indeed received considerable attention across linguistics and philosophy (see Lasersohn 1999; Krifka 2007; Solt 2014; Aparicio 2017). In addition, it also affords an important window on language processing – and in particular on the strategies at play
as interlocutors navigate the task of resolving imprecision in conversation. This question has been
looked at by work across linguistics, philosophy and psychology, which primarily focuses on the
speakers’ perspective. A key notion in this line of work is that speaking imprecisely comes with a
range of benefits that can compensate for the loss in descriptive accuracy: it allows speakers to be
briefer (Krifka 2002, 2007); it diminishes the risk of providing irrelevant information (Lasersohn
1999); and it presents processing benefits for the addressee (Dubois 1987; Van Der Henst et al.
2002; Solt et al. 2017). Moreover, it’s been shown that the level of precision with which speakers
opt to describe the world correlates with the pragmatic relevance that details have in the speech
situation. For example, Lasersohn (1999) suggests that, while it is generally possible to say that
“all the townspeople are asleep” even if a few are indeed awake, this choice is less likely to be
made in a context in which even a handful of exceptions could be relevant to the interlocutors’
purposes – e.g., if someone is waiting for the townspeople to fall asleep so they can attack the
town and the ones that are awake happen to be standing guard. Similar claims have been made for
instances of (im)precision across different domains of the grammar, including modality (Klecha
2017), adjectives (Kennedy 2007; Syrett et al. 2009) and numerals (Van Der Henst et al. 2002;
Krifka 2007).

While this work greatly contributed to highlighting the context sensitive nature of imprecision
resolution, as well as its connection with a different aspects of cognition and reasoning, its mostly
speaker-centered perspective leaves several issues unexplored. In particular, little is known about
the processes and factors involved in comprehenders’ reasoning about the context as they resolve
the indeterminacy of quantity expressions, leaving important questions open. In particular, what
sources of contextual information do comprehenders recruit in the process, and how is this inform-
ation incorporated into the process leading to settling on their final interpretation? In this paper,
we contribute to answering these questions by investigating how the resolution of imprecision is
affected by the social identity of the speaker, a hitherto uncharted source of contextual information
in the interpretation of quantity expressions – and in pragmatic processing more broadly.

2.4 Imprecision and social meaning

The level of precision at which an utterance should be interpreted is not only relevant to the process
whereby interlocutors exchange propositional information; it also been shown to work as a salient
index of speaker features and qualities, and thus to be highly relevant to the social dimension of
meaning as well. Work in marketing and social psychology, for example, has suggested that the
use of sharp numbers – normally taken to signal a high level of precision (Krifka 2007) – boosts the
perceived competence of the speaker in a variety of domains. It enhances the perceived accuracy
of quantity estimation (Welsh et al. 2011) and the effectiveness of negotiators’ first offers, making
them “seem more informed of the good’s true value than negotiators who use round first offers”
(Mason et al. 2013); in addition, sharp numbers contribute to making an advertised company look
more competent (Xie and Kronrod 2012) or a product sound more likely to deliver on its promise
(Zhang and Schwarz 2011).2

More recently, work in linguistics has further unveiled the social significance of (im)precision
from the comprehender’s perspective. In particular, Beltrama (2018a) suggests that speakers de-

2By contrast, product characteristics described in round, hence less precise, numbers are perceived as more stable
and performing for a longer time, suggesting that lower levels of precision can also boost product attitudes on particular
dimensions (Pena-Marin and Bhargave 2016)
scribing events by means of sharp numbers are rated more highly than speakers using round numbers along a variety of favorable – e.g., articulate, intelligent, educated, hard-working – and less favorable dimensions – e.g., annoying, pedantic, obsessive, and uptight. More broadly, as Beltrama suggests, such associations between precise speech and social features can be seen as part of a broader associative pattern between detail-orientedness in speech and detail-orientedness as part of one’s identity – as extensively pointed out in work on the hyper-articulation of sounds. For instance, it’s been suggested that speakers especially attentive to detail in the way in which they pronounce sounds are generally re-analyzed as embodying the same degree of attentiveness as part of their identity (Eckert 2012; Podesva et al. 2015); similarly, Bucholtz (2001) suggests a principled link between the act of resisting the phonological pressure to simplify the realization of a phoneme and the practice of resisting assimilation to the crowd – an association that illuminates the central role of detail-orientedness to index personae such as nerds.

Looking at the broader picture, the rich implications of (im)precision for the perception of social meaning provide the opportunity of simultaneously testing important open questions both related to the study of (im)precision, and the study of the interaction between semantic and social meaning more generally. More specifically: can the very same socio-indexical associations that are linked to precise vs. less precise instantiations of numerals conversely guide how comprehenders resolve the indeterminacy required to assign a meaning to numerals at the semantic-pragmatic level?. As already discussed in §2.3, exploring this possibility provides an important opportunity to advance our understanding of how different dimensions of meaning relate to one another: it allows us to assess whether comprehenders can use social meaning as a cue to navigating and interpreting the semantic meaning of utterances; furthermore, it affords the possibility of investigating the effect of social information on language processing beyond the domains of phonological and syntactic phenomena, and thus of expanding how knowledge of how social meaning are embedded in the cognitive mechanisms whereby language is interpreted by listeners. The next section introduces an experimental paradigm designed to explore these issues, presenting two sets of experiments that we conducted to make progress in this direction.

3 Experiment 1 A-B

Our experiments utilize a picture selection task inspired by the covered box task previously used in the study of scalar implicatures and presuppositions (Huang and Snedeker 2013; Romoli and Schwarz 2015; Schwarz 2016) to address two questions. First, we ask whether, and how, the social persona embodied by the speaker affects the resolution of the speaker’s utterance, in particular the standard of (im)precision adopted by comprehenders. To the extent that there is such an effect, we hypothesize that an utterance produced by a speaker who is socially expected to speak precisely – in our paradigm, one embodying a Nerdy persona – will be held to a higher standard of precision than the same utterance uttered by a speaker who is socially expected to speak less precisely in comparison – in our paradigm, one embodying a Chill persona. Second, we investigate whether, and how, this effect is modulated by the extent to which the person who interprets such utterances identifies with these social categories, measured by the degree to which respondents in the experiment indicate themselves to be Nerdy and Chill in a post-experiment questionnaire. In this regard, we’re particularly interested in exploring whether the hypothesized trend towards a more precise interpretation with nerdy speakers – if present – is enhanced or weakened when respondents iden-
tify themselves as nerdy (in comparison to the overall distribution in the participant population).

3.1 Methods & Design

Our stimuli utilized visually displayed dialogues, with variants resulting from manipulations that crossed two factors in a 2x3 design. Before outlining the logic and procedure of the experiment, we introduce each manipulation separately.

3.1.1 Persona Manipulation

Our first manipulation varied the social identity of the displayed characters, and was implemented as a between subjects factor. Our goal was to create a contrast between two distinctively recognizable social personae that would elicit significantly different expectations in terms of how precisely they speak. Building on findings from the sociolinguistics literature, as well as on the constellation of social qualities that have been shown to be conveyed by variation in precision (see §2.3), we identified the contrast between a Nerdy and a Chill persona as especially suitable for our goals, with a speaker embodying a Nerdy persona expected to be associated with a higher standard of pragmatic precision than one embodying a Chill one. We implemented this manipulation by creating two types of visually presented characters engaged in conversation, which were realized with the cartoon drawing software Pixton. The first conversation consisted of stereotypically Nerdy characters, called Arthur and Rachel; and the second of two stereotypically Chill characters, named Alex and Eva. The dialogues were prefaced by a brief context sentence to situate the subsequent exchange in which Rachel or Eva would ask a question, and Arthur or Alex would respond based on information they accessed by looking at their phone, uttering a quantity expression in the form of a round number. Figure 1-2 illustrates the respective images that were used in the experimental trials.

To ascertain the effectiveness of the manipulation of the visual traits signaling the persona of the respective characters, we conducted a norming study to a) ensure that the Arthur and Alex are effectively recognized as embodying a Nerdy and a Chill persona respectively; and b) confirm that these personae were indeed associated with different expectations about the precision of their speech. Participants in this norming study were asked to perform three tasks: a) provide 4 attributes to describe each character; b) provide a specific stereotype that would fit the character; c) and rate how precisely they would expect each of the two characters to speak on a 1-100 scale. The results confirmed that Arthur and Alex are indeed associated with considerably disjointed sets of attributes and stereotypes. For Arthur, common adjectives included, in order of frequency, nerdy, studious, smart, intelligent and uptight, while stereotypical characterizations unanimously converged on nerd. For Alex, common attributes included fun, nice, laid-back, cool, friendly, while stereotypes included hipster, millennial, skater, hippie. Furthermore, Arthur was indeed expected to speak more precisely than Arthur (M= 87.2; sd = 17.69 vs. M = 48.03; sd = 31.45). Taken together, these results confirmed that Arthur and Alex could be safely associated with different personae, as well as with different expectations concerning the level of precision of their speech.

3 https://www.pixton.com
4 Note that while there are many interesting questions and further possibilities arising from other potential combinations of the personae of the two interlocutors, we opted for having both characters represent the same persona as the simplest first test case.
3.1.2 Screen Fit Manipulation

The second manipulation was a within subjects factor. After seeing the dialogue, participants were asked the question “Which phone is Arthur/Alex looking at” and were shown two images of a phone. In one image, the phone was turned face down, making the content of the screen invisible (COVERED screen). In the other image, the phone was turned face up with the display fully visible (VISIBLE screen). The visible screen displayed a number indicating cost, distance, or time, whose relation to the character’s utterance was varied by condition. Specifically, this factor came in three variants: the Match condition, in which the number fit the number uttered by the character, at least up to the decimal point for cost and distance, with a small divergence in cents and fractions of a mile respectively; the Mismatch condition, in which the number diverged from the number uttered by the character by a very large amount; and the critical Imprecise condition, in which the number on the screen only slightly diverged from the one uttered by the character, to an extent that could in principle be seen as negligible for the purposes at hand.

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[5] For time, including seconds in the display seemed like it might have too strong of an effect of imposing high precisions standards, since standard digital time displays on phones do not include seconds. Our second set of experiments, reported below, had values matching the uttered ones precisely, e.g., ending in ‘.00’ for prices and ‘.0’ for miles, to further assess the role this might play for imprecision thresholds.
The precise extent was divided into two ranges to further differentiate potential effects based on the amount of divergence, the NearMatch and NearNearMatch ranges. In the NearMatch range, cost and distance diverged from the uttered value by 12, 14, 16, or 18; and time diverged by 7, 9, 11, or 13. In the NearNearMatch range, cost and distance diverged from the uttered value by 5, 6, 8, or 9; and time diverged by 1, 2, 3, 4 or 5. The ranges of divergence for times were smaller since proportionally, a minute makes up a greater proportion of an hour (1/60th) than 1 mile or dollar makes of a 100 miles/dollars, and quarter hour intervals intuitively constitute a salient degree of coarseness.

3.1.3 Task

Participants were instructed to select the visible screen if they believed ‘that this was the phone the speaker was looking at’ (see full instructions below); and to select the covered screen if they believed it wasn’t. The Match and the Mismatch conditions are expected to evoke covered responses at floor and ceiling levels respectively. By contrast, responses in the Imprecise condition crucially depend on imprecision standards employed by participants in the specific response context: a relatively strict interpretation – that is, one with a standard of precision that excludes the value displayed on the visible screen – should lead to a covered screen response; and a relatively lenient interpretation – that is, one with a lower level of precision, which includes the value displayed on the visible screen – should translate into a visible screen choice. Accordingly, if the social identity of the speaker plays a role in resolving imprecision in the direction we hypothesize, we predict a higher rate of covered choices for Nerdy speakers than for Chill speakers in the Imprecise condition.

3.2 Materials

24 experimental items were created, each varied across 6 different conditions resulting from the 2×3 manipulation of the factors described above (Persona: Nerdy, Chill; Screen Fit: Mismatch, Match, Imprecise). The Persona manipulation was administered between-subjects: a given participant was either assigned to dialogues between the Nerdy characters or between the Chill characters.
The Screen Fit manipulation was administered within-subjects: each participant saw 6 items in the Match and the Mismatch conditions and 12 items in the Imprecise condition (half in the NearMatch variant, and half in the NearNearMatch variant), with item-condition pairings counterbalanced in a Latin Square Design. 8 items contained utterances describing prices, expressed in dollars (as in Figure 1-5); 8 items contained utterances describing distances, expressed in miles; and 8 items contained items describing times, expressed in hours and minutes. The cost and distance items had cents and fractions of miles displayed after the decimal point to avoid a complete visual match between the display and the utterance (this was varied in Experiment 2, as will become clear in §4).

The experiment also included 24 filler items, which featured a dialogue between two separate characters called Becky and Tyler. The dialogue was also prefaced by a brief context sentence and was concluded by Tyler uttering a description with the quantifier some. In 8 filler items the visible screen would report a list of items which would make the description true; in 8 filler items it would report a list of items that would make the description false; and in 8 filler items, it would make the description under-informative, in that an ‘all’ statement would also have been true, thus yielding a condition where acceptance of the visible picture would correspond to adopting a literal ‘some and possibly all’ meaning of ‘some’, parallel to standard studies on scalar implicatures. The fillers were alternated with the experimental items, so that participants would never see two consecutive occurrences of a filler or an experimental item. Figure 4 shows an example of a filler.

"Becky and Tyler are looking for a venue for an event"

Figure 4: Filler item

3.3 Procedure

The study was implemented and administered online on the PCibex platform (https://www.pcibex.net; see Zehr and Schwarz 2018 for details). After providing informed consent, participants were shown the instructions, reproduced in the box below.
**Instructions.** We’re going to play a little guessing game: you’ll see some cartoon-like dialogues where one person asks another one a question. That person checks their phone and responds based on information they see there. You’ll then be presented with two phone pictures. In one of them, you can see the details of the screen, while in the other one the phone is turned upside down. Your goal will be to guess which of the two phones is the one that the person is looking at, based on what this person is saying in the picture. As a general rule, you’ll select the phone with the visible screen if you think that the information on the screen fits what is being said. You’ll select the one turned upside down, instead, if you think that the information on the visible screen does not fit with what the person said. Note that just one of the pictures goes with what the second person responds. So you should only choose the phone that’s turned upside down if you don’t think the person giving the answer would have said what they did if they had been looking at the visible phone screen”.

For each item, the context sentence was introduced first on the top left of the screen. After a 4-seconds pause to provide time to read this, images of the two characters would appear; after another 3-seconds pause to allow time to look at these characters (and the critical visual cues on their persona, on critical trials), the question asked by the first character was shown in the form of a speech bubble; following another 3 seconds pause, the answer from the other character was displayed to complete the dialogue. Finally, the question reminding the participant of the experimental task as well as the two pictures of the phone appeared on the right-hand side of the screen. Participants entered their responses by pressing a key matching the letter displayed under the picture on the keyboard. The experimental items were preceded by three practice filler items in which the response would involve the use of a quantifier, and the content of the visible screen would be either a perfect match or an obvious mismatch. Feedback was provided on the practice items, so as to help the participants familiarize themselves with the task. Besides the screen choice, response times for making this choice were also recorded; however, they will not be discussed in this article (see [AUTHORS XXXX] for further details). Figure 5 provides a full illustration of the display that participants would see once all the elements appeared.
Following the last trial, all participants, regardless of whether they had been assigned to the Nerdy or the Chill condition, were asked to respond to an exit questionnaire aimed at assessing their own positioning with respect to the two social personae. The questionnaire consisted of the two questions below; participants responded by selecting a value on a 1-10 scale, with 1 indicating the minimum value and 10 indicating the maximum value. The two questions were presented incrementally.\textsuperscript{6}

\begin{enumerate}
\item How nerdy do you consider yourself to be? 1 \ldots 10
\item How chill do you consider yourself to be? 1 \ldots 10
\end{enumerate}

### 3.4 Participants

In version A of the experiment, 168 participants were recruited online on Prolific and compensated $1.30 for participating. In version B of the experiment, 133 participants were recruited from the [AUTHORS’ INSTITUTION] psychology subject pool, which consists of undergraduate students taking coursework in psychology or linguistics, who participate in experiments for course credit. In order to take part in the study, subjects were required to self-identify as native speakers of English. All participants provided informed consent approved by the [AUTHORS’ INSTITUTION]'s Institutional Review Board.

### 3.5 Results and Statistical Analysis

Our data analysis focused on three components: first, we confirm that the basic manipulation was successful by ascertaining that our critical condition falls into the relevant range of plausible imprecision thresholds, with correspondingly mixed response choices compared to the controls. To

\textsuperscript{6}Links to the full online experiment for both lists containing Nerdy and Chill characters are provided in the Appendix.
this end, we compare the overall rate of COVERED responses in the Imprecise condition with the two control conditions. Secondly, we home in on the Imprecise condition and explore our central hypothesis concerning the impact of the Persona manipulation on the rate of COVERED responses; we also explore any potential additional effects of the imprecision range as part of this analysis, testing for both main effects of range and an interaction between range and persona. Finally, we turn to the question on the extent to which the Persona effect is modulated by the relation of the experimental participants’ own identity to the persona of the speaker.

3.5.1 Testing for variation in imprecision thresholds

Figures 6-7 illustrate the overall proportion of COVERED choices across the three Screen Fit conditions. These graphs suggest a clear step-wise effect of differences, with ceiling and floor-level response rates for the controls, and the imprecise condition in the middle, as expected.

For statistical analysis, we fit a mixed-effects logistic regression with Screen Fit as a fixed effect, and by-Subject and by-Item random intercepts (which constituted the maximally complex random effect structure that would converge). To assess whether response choice rates in the Imprecise condition were significantly different from those in the controls, we set it as our reference level for the model. The model – and all the other models throughout the paper – was computed with the “glmer” function from the lmerTest package (Kuznetsova et al. 2016). The output from the model for both experiments is summarized in Table 1: both the Mismatch and the Match conditions significantly differ from the Imprecise condition, confirming that we are overall in the right range of divergence from the precise meaning to tap into variation in the imprecision thresholds that participants adopt. This establishes the basis for assessing our main question about the impact of the speaker’s persona on imprecision thresholds.
<table>
<thead>
<tr>
<th>Level</th>
<th>Expt 1A: Prolific</th>
<th>Expt 1B: Uni subject pool</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coeff.</td>
<td>SE</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.86</td>
<td>0.21</td>
</tr>
<tr>
<td>Mismatch</td>
<td>6.66</td>
<td>0.28</td>
</tr>
<tr>
<td>Match</td>
<td>-4.67</td>
<td>0.33</td>
</tr>
</tbody>
</table>

### 3.5.2 The Persona effect

To explore the Persona effect on screen choices, our next analyses exclusively model data for the Imprecise condition, and also incorporate the two imprecision ranges as an additional factor. Figures 8–9 illustrate proportions of covered choices within the Imprecise condition, and across the NearMatch (5–11% over 60 min/100 miles deviation from the precise value) and NearNearMatch subclasses (12–18% deviation). Inspection of the graphs suggests higher rates of covered choices for Nerdy speakers in both the NearMatch and NearNearMatch variants, as well as overall lower rates of covered choices in the NearNearMatch condition, as would be plausible.

![Figure 8: Experiment 1A: Prolific](image1)

![Figure 9: Experiment 1B: Uni subject pool](image2)

To assess these contrasts statistically, we fit a mixed-effects logistic regression with Imprecision range (NearMatch vs. NearNearMatch), Persona and their interaction as fixed effects, and by-Subject and by-Item random intercepts (models including random slopes did not converge). Given our hypothesis and research question, we are primarily interested in the effects of the Persona manipulation, which could arise either across the board or only within one of the two Imprecision ranges. For our model, we centered both predictors, to assess the key main effect of Persona, as well as of Imprecision range and a potential interaction of the two. The model output for both experiments is reported in Table 2.

---

This effectively corresponds to sum-coding, with slight deviation in values due to some imbalances across the various cells of our design.
Table 2: Mixed-effects models summary for Persona and Amount of Imprecision (sum coded): Experiment 1.

<table>
<thead>
<tr>
<th>Level</th>
<th>Expt 1A: Prolific</th>
<th>Expt 1B: Uni subject pool</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coeff.  SE   p</td>
<td>Coeff.  SE   p</td>
</tr>
<tr>
<td>Intercept</td>
<td>–1.17 0.29 &lt;.001</td>
<td>–1.42 0.28 &lt;.001</td>
</tr>
<tr>
<td>Imprecision Range</td>
<td>–2.47 0.17 &lt;.001</td>
<td>–2.92 0.20 &lt;.001</td>
</tr>
<tr>
<td>Persona</td>
<td>1.23 0.49 &lt;.05</td>
<td>1.23 0.46 &lt;.01</td>
</tr>
<tr>
<td>Persona*Am.-of-Imprecision</td>
<td>–0.49 0.43 .14</td>
<td>0.16 0.37 0.66</td>
</tr>
</tbody>
</table>

As predicted, we find a significant main effect of Persona in both experiments, statistically confirming a higher rate of covered choices for Nerdy speakers. In addition, we find a main effect of Imprecision range, confirming that the rate of covered choices is higher in the NearMatch condition than it is in the NearNearMatch condition, as is intuitively plausible. However, we do not find a significant interaction, suggesting comparable Persona effects across both ranges.

### 3.5.3 Participants’ Identity in relation to speaker persona

Our final analysis looks at whether, and to what extent, the Persona effect is modulated by respondents’ own identity in relation to the speaker’s persona. As reported above, participants from either list provided a score for their self-ascribed degree of nerdiness and chillness, which ranged from 1 to 10. To explore whether the Persona effect on the screen choices is modulated by respondents’ identity in relation to the speaker’s persona – specifically by whether participants identify themselves with vs. distance themselves from the Nerdy and Chill personae – we used the median of these scores to divide participants in two independent categories: Nerdy vs. non-Nerdy; and Chill vs. non-Chill. Table 3 provides a breakdown of the categories for each subject population.

Table 3: Distribution of participants across self-ascribed ratings of Chill and Nerdy for Experiment 1

<table>
<thead>
<tr>
<th></th>
<th>Nerdy</th>
<th>Non-Nerdy</th>
<th>Median</th>
<th>Average</th>
<th>Chill</th>
<th>Non-Chill</th>
<th>Median</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exp 1A</td>
<td>86</td>
<td>82</td>
<td>8</td>
<td>6.92</td>
<td>91</td>
<td>77</td>
<td>8</td>
<td>7.21</td>
</tr>
<tr>
<td>Exp 1B</td>
<td>52</td>
<td>81</td>
<td>7</td>
<td>6.60</td>
<td>64</td>
<td>69</td>
<td>7</td>
<td>6.84</td>
</tr>
</tbody>
</table>

These groupings were then used to create a new factor, which we name Ingroupness. This factor had level INGROUP if, for a given data point, the participant’s and the speaker’s identity matched, i.e., when a nerdy participant performed the screen choice task with nerdy Arthur as speaker; or when a chill participant performed the screen choice task with chill Alex. This factor had level OUTGROUP if the two identities didn’t match, i.e., when a non-nerdy character performed the screen choice task with nerdy Arthur; or when a non-chill character performed the screen choice task with chill Alex. The results broken down by Persona and Ingroupness are shown in Figure 10-11 for the two variants of the experiment. Inspection of the graphs suggests that the Persona effect is consistently clear for the Outgroup data, but perhaps less so (1B), or not at all (1A) present for the Ingroup data.
To assess any potential differences statistically, we fit a further mixed-effect model with Persona (i.e., Chill vs. Nerd) and Ingroupness as fixed effects and random intercepts for Items and Subjects for Experiment 1B and only a random intercept for Items for Experiment 1A (more complex random effect structures did not converge). The predictors were again centered (effectively sum-coded, as above) to test for main effects and an interaction. The output from the models is summarized in Table 4 below.

Table 4: Mixed-effects models summary for Persona and Ingroupness (sum coded): Experiment 1

<table>
<thead>
<tr>
<th>Level</th>
<th>Expt 1A: Prolific</th>
<th></th>
<th></th>
<th>Expt 1B: Uni subject pool</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coeff.</td>
<td>SE</td>
<td>p</td>
<td>Coeff.</td>
<td>SE</td>
<td>p</td>
</tr>
<tr>
<td>Intercept</td>
<td>–0.62</td>
<td>0.01</td>
<td>&lt;.001</td>
<td>–1.03</td>
<td>0.19</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Persona</td>
<td>0.58</td>
<td>0.10</td>
<td>&lt;.001</td>
<td>0.81</td>
<td>0.32</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>Ingroupness</td>
<td>–0.02</td>
<td>0.09</td>
<td>.80</td>
<td>0.52</td>
<td>0.33</td>
<td>0.11</td>
</tr>
<tr>
<td>Persona*Ingroupness</td>
<td>1.44</td>
<td>0.20</td>
<td>&lt;.001</td>
<td>0.16</td>
<td>0.66</td>
<td>0.76</td>
</tr>
</tbody>
</table>

Consistent with the findings from the previous step of the analysis, we find a main effect of Persona in both studies. In Experiment 1B, this is the only significant effect we find. However, in Experiment 1A, the Persona effect is crucially modulated by Ingroupness, as shown by the significant interaction between Persona and Ingroupness: in the Outgroup condition, the rate of covered screen responses is considerably higher for the Nerdy characters than it is for the Chill characters. This effect was found to be significant in a variant of the model using treatment coding with Outgroup as the baseline ($\beta = -1.36, SE = 0.16, p < .001$), whereas there was no significant effect of Persona at the Ingroup level. The main effect of Persona here is thus entirely driven by the Outgroup data. While there was no comparable interaction in Experiment 1B, it is worth noting that there is a numerical trend for the difference between Nerdy and Chill characters to be larger in the Outgroup condition than for the Ingroup condition (Ingroup: 0.25 vs. 0.34; Outgroup: 0.29 vs. 0.44), consistent with the interaction found for Experiment 1A.
3.6 Experiment 1A-B: discussion

Experiments 1A-B explore the effect of social information in the form of a manipulation of speaker persona on the resolution of pragmatic imprecision in participant populations drawn from two distinct pools: subjects recruited from Prolific; and subjects recruited from the [AUTHORS’ INSTITUTION] undergraduate subject pool. We were especially interested in two questions: how the social persona embodied by the speaker affects the threshold of imprecision applied to the interpretation of a numerical expression; and how this effect, if present, is modulated by the experimental participants’ own social positioning with respect to these categories. Concerning the first question, we found an effect of persona in the expected direction for both experiments: the rate of covered responses, which we take to be indicative of a higher standard of precision, is higher when utterances are produced by Nerdy speakers, as opposed to Chill ones. This suggests that social expectations about linguistic behavior based on the speaker’s social identity directly impact the resolution of imprecision thresholds. This effect is robust across the two different participant populations we tested.

Concerning the second question, our results suggest that the effect of Persona on screen choice can be modulated by participants’ own self-ascribed identity in relation to the speaker’s persona: specifically, for the Prolific population, the Persona effect is limited to situations in which the identity of the experimental participants does not align with the identity of the character producing the utterance for Experiment 1A. For the [AUTHORS’ UNIVERSITY] undergraduate population, the effect holds across the Ingroup and Outgroup contexts, without any significant interaction, though with numerical trend towards being stronger in the Outgroup situation as well.

In light of the mixed results with regards to the role of participants’ identity in relation to the speaker persona, we conducted a second set of experiments, again drawing on the two different participant populations. These incorporate one additional small manipulation concerning the nature of the stimuli in the Match condition. While Experiments 1A-B had matches to the uttered value that matched up to the decimal point, but diverged at the level of cents or fractions of a mile for cost and distance, the Match condition in Experiments 2A-B matched the uttered values precisely, displaying the decimal parts of prices and distances as ‘.00’ or ‘.0’ respectively. This was done to assess to what extent the relatively easy availability of imprecise interpretations was enhanced by the absence of any full precise matches throughout the experiment.

4 Experiment 2

4.1 Design, Materials and Procedure

Experiments 2A-B were largely a replication of Experiments 1A-B, except for the change in the Match condition described at the end of the previous section: whereas the values in Experiment 1A-B deviated by cents or fractions of a mile from the uttered value, they match precisely all the way in Experiments 2A-B, yielding a perfect correspondence between the description uttered by the character and the content on the visible screen, thus not requiring any reasoning whatsoever about (im)precision to provide a response in this particular condition. The resulting Screen Fit manipulation is illustrated in Figure 12.
4.2 Participants

In version A of the experiment, 141 participants were recruited online on Prolific and compensated $1.30 for participating. In version B of the experiment, 132 participants were recruited from the [AUTHORS’ INSTITUTION] psychology subject pool, which consisted of undergraduate students taking coursework in psychology or linguistics at this institution, who received course credit for participating.

4.3 Results

Parallel to Experiment 1, our analysis focuses on three aspects: an overall assessment of the Screen Fit manipulation; an assessment of the Persona effect within the Imprecise condition (as well as of potential effects of Imprecision range); and an assessment of the modulation of participants’ identity in relation to speaker persona on the Persona effect. In addition, given the cross-experiment variation of the Match condition, we also analyze the impact of this manipulation across the two sets of experiments.

4.3.1 Testing for variation in imprecision thresholds

Figures 13-14 illustrate the overall proportion of covered choices across the three Screen Fit conditions, again with the expected intermediate results pattern for the Imprecise condition relative to the controls.
Following the same approach as in the analysis of Experiment 1, we tested for statistical significance of this pattern by fitting a mixed-effects logistic regression with Screen Fit as a fixed effect, and by-Subject and by-Item random intercepts, using treatment coding with the Imprecise condition as baseline. The output from the model from both experiments is reported in Table 5: as predicted, both the Mismatch and the Match conditions significantly differ from the Imprecise condition.

Table 5: Mixed-effects models summary for Screen Fit: Experiment 2. Intercept: Imprecise

<table>
<thead>
<tr>
<th>Factor</th>
<th>Expt 2A: Prolific</th>
<th>Expt 2B: Uni subject pool</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coeff.</td>
<td>SE</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.16</td>
<td>0.26</td>
</tr>
<tr>
<td>Mismatch</td>
<td>7.16</td>
<td>0.53</td>
</tr>
<tr>
<td>Match</td>
<td>-8.23</td>
<td>0.60</td>
</tr>
</tbody>
</table>

### 4.3.2 The Persona effect

As in Experiment 1, we explored the Persona effect on screen choices by focusing on the data in the Imprecise condition. Figures 15-16 illustrate proportions of covered choices within the Imprecise condition, and across the NearMatch (5-11% over 60 min/100 miles deviation from the precise value) and NearNearMatch subclasses (12-18% deviance). As can be seen from the graphs, the rate of covered choices appears to be higher with Nerdy speakers across the NearMatch and NearNearMatch categories for Experiment 2A; no clear overall pattern is evident in this regard for Experiment 2B. With regards to the Imprecision range factor, we again seem to see higher levels of covered choices for the NearMatch conditions than the NearNearMatch ones.
Again, we assessed these contrasts statistically by fitting a mixed-effects logistic regression with Amount of Imprecision (NearMatch vs. NearNearMatch), Persona and their interaction as fixed effects, and by-Subject and by-Item random intercepts (models including random slopes did not converge). As before, we are primarily interested in the effects of the Persona manipulation, and we again centered both predictors for our model, to test for possible main effects and interactions. The output from the model from both experiments is reported in Table 6.

Table 6: Mixed-effects models summary for Persona and Amount of Imprecision (sum coded): Experiment 2.

<table>
<thead>
<tr>
<th>Level</th>
<th>Expt 2A: Prolific</th>
<th>Expt 2B: Uni subject pool</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coef.</td>
<td>SE</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.25</td>
<td>0.32</td>
</tr>
<tr>
<td>Imprecision Range</td>
<td>−2.26</td>
<td>0.18</td>
</tr>
<tr>
<td>Persona</td>
<td>1.23</td>
<td>0.59</td>
</tr>
<tr>
<td>Persona*Am.-of-Imprecision</td>
<td>0.41</td>
<td>0.34</td>
</tr>
</tbody>
</table>

We find a significant effect of Persona in the Imprecise condition for Experiment 2A, similar to Experiment 1A. However, the same effect was not present for Experiment 2B, for which the rate of covered choices in the Imprecise condition does not differ for Nerdy vs. Chill characters. The difference across the two levels of Imprecision Range is again significant for both data sets, but there is no interaction between the two factors.

4.3.3 Participants’ Identity in relation to speaker persona

Using the median as the dividing point, as we did in the previous set of experiments, participants were split into two independent groups: Nerdy vs. non-Nerdy; and Chill vs non-Chill. Table 7 provides a breakdown of the categories for each subject population.
Table 7: Distribution of participants across self-ascribed ratings of Chill and Nerdy: Experiment 2

<table>
<thead>
<tr>
<th></th>
<th>Nerdy Median</th>
<th>Nerdy Average</th>
<th>Chill Median</th>
<th>Chill Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exp 2A</td>
<td>54</td>
<td>7</td>
<td>6.49</td>
<td>76</td>
</tr>
<tr>
<td>Exp 2B</td>
<td>47</td>
<td>7</td>
<td>6.71</td>
<td>71</td>
</tr>
</tbody>
</table>

As in Experiment 1, we then used the resulting Ingroupness distinction to explore how the Persona effect is modulated by respondents’ own identity. Figure 17-18 show the screen choice results for the Imprecise condition modulated by Ingroupness. The graphs suggest effects of Persona in the expected direction for the Outgroup data, but not for the Ingroup data.

Figure 17: Choices by participants’ identity: Prolific

Figure 18: Choices by participants’ identity: Uni subject pool

To assess the modulation of Persona effects by participants’ own self-ascribed identity relative to the speaker’s Persona (i.e., Ingroupness) statistically, we fit a mixed-effect model with Persona (i.e., Alex vs. Arthur) and Ingroupness as fixed effects and random intercepts for Items and Subjects (more complex random effect structures did not converge). The factors were centered to test for main effects and interactions. The output from the models is summarized in Table 8 below.

Table 8: Mixed-effects models summary for Persona and Ingroupness (sum coded): Experiment 2

<table>
<thead>
<tr>
<th>Level</th>
<th>Expt 2A: Prolific</th>
<th>Expt 2B: Uni subject pool</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coeff.</td>
<td>SE</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.13</td>
<td>0.26</td>
</tr>
<tr>
<td>Persona</td>
<td>1.02</td>
<td>0.47</td>
</tr>
<tr>
<td>Ingroupness</td>
<td>0.32</td>
<td>0.47</td>
</tr>
<tr>
<td>Persona*Ingroupness</td>
<td>2.02</td>
<td>0.96</td>
</tr>
</tbody>
</table>

Across both experiments, we see an interaction between Persona and Ingroupness, with relatively greater rates of covered choices for Nerds in the Outgroup condition. For Experiment 2A, we
find a main effect of Persona in Experiment 2A indicating overall higher rates of covered choices for Nerds, consistent with the findings from previous analysis, though in light of the interaction, it is now clear that this is driven by the Outgroup data. For Experiment 2B, there is no main effect of Persona, apparently due to a potential effect in the opposite direction for the Ingroup data. To assess the nature of the crucial interaction further, we re-ran the analyses using treatment coding and appropriate variations of which level is set as the baseline. As could be expected from the graph, for Experiment 2A there only is a significant effect of Persona for the Outgroup data ($\beta = -2.07, SE = 0.69, p < .01$), and not for the Ingroup data. For Experiment 2B, there is a marginally significant effect of Persona at the Outgroup level ($\beta = -1.15, SE = 0.68, p < .1$), and none at the Ingroup level. While the picture is slightly less clear-cut statistically in this last case, with a merely marginally significant simple effect, looking at the interactions across experiments where we find them (everywhere except for Experiment 1B), the Persona effect is driven primarily or exclusively by the Outgroup data.

### 4.3.4 Cross-experiment comparison: varying precision in the Match-condition

Experiments 1 and 2 differed in whether the values displayed in the visible phone picture in the Match condition for cost and distance diverged minimally by a few cents or tenths of a mile, or whether they had precise matches all the way past the decimal point. The change to the latter was implemented to ensure that the relatively high acceptance in the Imprecise condition was not solely due to completely precise matches being extremely rare (as they only occurred in the 6 time items in the Match condition throughout the experiment). At the same time, testing the impact of the make-up of the entire set of trials in the experiment on the behavior in the Imprecise condition provides another angle at potential factors that could affect the participants’ choices in setting their imprecision thresholds for the Imprecise condition.

We thus conducted a cross-experiment analysis, pooling together the data from all four (sub-)experiments, fitting a logistic regression with Experiment (1 vs. 2) and Persona as centered predictors, as well as their interaction, and random intercepts for subjects and items, as well as a random by-item slope for the Experiment factor (the maximal appropriate random effect structure that would converge). There was no significant interaction, but we find an overall significant main effect of Persona ($\beta = -0.78, SE = 0.21, p < .001$), reinforcing the overall importance of the Persona factor in the combined data set; and also a significant effect of Experiment ($\beta = 0.76, SE = 0.22, p < .001$), confirming that the small change in 12 trials per participant in the Match condition (from, e.g., $200.06 to $200.00) impacted the setting of imprecision thresholds, leading to roughly a 10% increase in covered picture choice rates in the Imprecise condition in Experiment 2, where the Match condition had completely precise matches throughout. While this result is secondary to our main theoretical focus, it should be kept in mind for future work, as it shows that participants behavior with regards to adopting imprecision thresholds is affected by a variety of factors, including detailed features of the overall make-up of experimental trials throughout the experimental session.

### 4.4 Experiments 2A-B: Discussion

Experiments 2A-B explore the same two questions as Experiments 1 A-B with a minimally modified design – one in which the Match condition features a full correspondence between the ut-
terance content and the Visible screen content. This change resulted in an overall increase of choices across the board for both experiments. With regards to our central questions concerning the role of speaker’s Persona for Imprecision resolution, the two variants of Experiment 2 show a significant interaction between Ingroupness and Persona in line with the parallel finding for Experiments 1A. In the Outgroup configuration, when the identity of the experimental participants does not align with the identity of the character producing the utterance, we observe a Persona effect; by contrast, no significant Persona effect emerges in the Ingroup data, when the identities of participants and characters do not align. The specific nature of the interaction varies slightly across the A and B variants, with no main effect of Persona for the latter, but a significant main effect for the former, albeit the analyses of the simple effects revealed that this is driven exclusively by the Outgroup data. Thus the main take-away from this set of experiments is that Persona does significantly affect the setting of imprecision thresholds, but this is crucially modulated by the relation of the participant’s own identity to the speaker’s Persona, with effects of the latter only – or at least primarily – appearing when the two do not align.

4.5 Interim Summary

Taken together, the data from both sets of experiments provide a number of insights on imprecision in interpretation: first, our Imprecise condition clearly tapped into a reasonable range of imprecision, as we find distinct results from controls throughout, confirming that participants accept the values displayed here as corresponding to the uttered values to a varying extent, leaving room to investigate what factors affect this variation in setting imprecision thresholds. With regards to our central theoretical question, the findings show that the resolution of imprecision is affected by the social identity of the speakers – and specifically, the Persona that they embody in the discourse context. However, to a large extent, this effect is crucially modulated by the respondents’ own social identity in relation to the speaker’s Persona. In three of our four (sub-)experiments, we find a significant interaction, such that the Persona effect is only present in the Outgroup data, where the social identity of the participants and the speaker do not align. In contrast, in Experiment 1B, there was no interaction, but an overall main effect of Persona. This main effect was also present in Experiments 1A and 2A, though here the simple effect analyses revealed that it was dominated by the interaction, and solely driven by the Outgroup data. Finally, Experiment 2B did not exhibit a main effect of Persona, but did show the interaction and a marginally significant simple effect for the Outgroup data. We now turn to a broader discussion of these results.

5 General Discussion

Our two sets of studies investigated whether, and how, the social identity of the speaker – as conveyed by independently normed visual features of Nerdy vs. Chill personae – shapes participants’ interpretation of numerals – and in particular, the calculation of the (im)precision standard required to assign a meaning to the expression. We further investigated how such a Persona effect might be mediated by participants’ own self-disclosed characterization with respect to these social personae. We now turn to a general discussion of the findings in regards to each of these questions, focusing on what they can reveal about the interaction between semantic, pragmatic, and social dimensions of linguistic meaning. The section is divided as follows. §5.1 addresses the influence of speaker
persona on the resolution of imprecision; §5.2 discusses the role of participants’ own identity in mediating the persona effect.

5.1 Speaker persona and imprecision resolution

The first central takeaway of our results is that the social identity of the speaker – and the expectations it generates with respect to the speaker’s typical linguistic behavior – can affect the precision with which their utterances are interpreted. Specifically, given identical utterances, listeners overall utilize stricter precision standards when the speaker embodies a persona that is stereotypically expected to speak precisely – i.e., the Nerdy character – than when the speaker embodies a persona who is expected to speak more loosely (or at the very least less distinctively precisely) – i.e., the Chill character. Note that, in 3 of our 4 studies, this effect was crucially mediated by how the participant’s own identity related to the speaker’s persona. In the remainder of this section, we structure our discussion by focusing on the Persona effect first, and only then turning to the modulating role of the participant’s identity. Several reasons motivate this choice: first, in Experiment 1A, there was no interaction of the relevant sort, suggesting a general Persona effect at least in this data set; second, conceptually, the presence of any Persona effect – whether as a genuine main effect or as a simple effect for certain subsets of data – has largely similar theoretical repercussions for our purposes; and finally, we deem it easier from a presentational standpoint to first lay out this type effect on its own, and then discuss its modulation by other factors in a second step.

Theoretically speaking, we take the Persona effect to be relevant to the study of meaning from two distinct perspectives. From the perspective of semantics and pragmatics, it highlights the importance of social information about the speaker as a relevant factor that can impact relatively fine-grained aspects of constructs formally modeled in the theoretical literature, such as – in the case at hand – the setting of imprecision thresholds required to assign a meaning to numerical expressions. As discussed in §2.2, previous work on imprecision processing showed that a variety of contextual factors play a role in the process whereby the indeterminacy associated with the interpretation of number words is resolved – including the situational relevance of details (Lasersohn 1999; Kennedy 2007), the interlocutors’ conversational goals (Aparicio 2017), or the modality of presentation of the information (e.g., analog vs. digital, Van Der Henst et al. 2002). The Persona effect in our data can be conclusively attributed to the contrast in social identity between Arthur and Alex, as everything except for the persona represented by the speaker – including the content of the utterances and the overall discourse context – was kept constant across conditions. This indicates that the interpretation of quantity expressions is not merely informed by the speakers’ communicative goals as rational agents in the context, but also by information and expectations about their identity and behavior – which crucially apply above and beyond the specific conversational situation, and might be independent of their communicative intentions.

From the perspective of the study of social meaning, these findings provide further evidence supporting the idea that social information – including persona-level constructs – is deeply integrated in the dynamics of linguistic processing. As discussed in §2.1, recent work unveiled the importance of social information for phonetic (Niedzielski 1999; Staum Casasanto 2008; Hay 2009; D’Onofrio 2015, 2018, 2019) and, to a lesser extent, syntactic processing (Campbell-Kibler 2010; Weatherholz et al. 2012; Squires 2013). Based on our studies, the pragmatics of adopting imprecision thresholds in the application of precise semantic interpretations in context emerges as another realm in which this integration is observed. This is an important step forward for two
independent reasons: it expands the set of domains of language processing in which listeners’ behavior is affected by social information; and more importantly for the study of meaning in general, it provides evidence that the interplay between social and descriptive dimensions of meaning is genuinely bi-directional. Not only do interlocutors recruit the semantic and pragmatic properties of linguistic expressions to form an evaluation of the speaker’s identity and behavior, as shown in prior work; they also rely on their evaluation of the social identity of the speaker to navigate the uncertainties inherently involved in putting precise meanings to use, and ultimately settle on a contextually appropriate interpretation of linguistic expressions.

Taken together, these observations show the need for a more integrated perspective on the dynamic interplay of social and semantic-pragmatic dimensions of meaning, highlighting their ability to jointly shape the message conveyed by linguistic utterances. In particular, our findings suggest that dimensions of social meaning such as persona-level constructs social are part and parcel of the array of contextual sources that interlocutors can draw on in the overall interpretation process, and specifically in resolving indeterminacies such as those involved in dealing with imprecision that might arise along the way. While models of pragmatic inferences such as those proposed by Acton (2014, 2019) and Burnett (2017, 2019) provide a compelling case that (certain dimensions of) the communication of social meanings can be successfully captured with the tools of formal pragmatics, and that social meanings can be sometimes “derived” via inferential processes akin to those typical of traditional pragmatics, the emerging picture is one in which the parallel between these dimensions runs deeper – that is, in which social meanings can interact with, and ultimately affect the computation of fine-grained parameters of meaning interpretation. As a result, more work is needed to develop a view of meaningful communication that is broad enough to fully embrace the interaction between these different layers of content on all these different levels.

Looking ahead, and considering the results from our experiments, two question emerge as especially relevant for undertaking this endeavor. One issue concerns the online processing mechanisms involved in integrating the various dimensions of meaning. One way of shedding light on this will be to assess the time-course with which the information on the social identity of the speaker is integrated in processing. More specifically, it will be interesting to assess whether social information is brought into play in pragmatic reasoning simultaneously with other dimensions that have been shown to play a role in the process – e.g., the interlocutors’ goals, contextual relevance etc.– or whether there are sequential steps in which different streams of information are considered. Since our discussion here is limited to offline judgments on screen choices, we cannot dive into this issue here further; but we see the analysis of the response time data in our results, which we plan to report in separate work, as a viable avenue to make progress in this direction. Even more fine-grained temporal dependent measures, e.g., eye movements in a visual world paradigm, should likewise hold promise to shed light on this issue.

A second question concerns the generalizability of speaker identity effects on meaning processing across different pragmatic phenomena. As laid out in §2.3, imprecision constitutes an ideal test case for pursuing these questions, as it combines the challenge of listeners having to resolving indeterminacy with prior findings showing that it is a productive index of social meanings on different dimensions. Does the social identity of the speaker likewise inform the interpretation processes for phenomena that are less clearly linked to social indexicality? A natural candidate to consider, for example, is the processing of scalar implicatures, a domain of central concern in work on pragmatic processing (Noveck 2001; Papafragou and Musolino 2003; Geurts 2006), but one whose interplay with social meaning has not been extensively explored (though see Bonnefon
and Villejoubert 2006; Mazzarella et al. 2018 for work on the relationship between the calculation of implicatures and social considerations about politeness and face). Another related approach in the recent literature looks at a different aspect of speaker identity, manipulating their presentation as native vs. non-native speakers, and finds that listeners judge the very same incomplete descriptions of the same novel invention to be more under-informative when uttered by native speakers (Fairchild et al. 2020). This suggests that a variety of aspects of speaker identity can affect a variety of aspects of meaning resolution, calling for much more extensive exploration of both of these dimensions.

5.2 The role of participants’ identity in modulating persona effects

The second important finding of our studies concerns the role of participants’ own identity in relation to the speaker’s persona in modulating the impact of speaker information on imprecision processing. In particular, in three out of our four experiments (1A, 2A-B), the Persona effect on imprecision resolution is only present when the respondent’s own social identity does not align with the one of the speaker – i.e., when self-ascribed non-nerdy participants are adjudicating nerdy characters, or self-ascribed non-chill participants are adjudicating chill characters. (The fourth experiment, 1B, exhibits a numerical trend towards a stronger effect in the Outgroup configuration as well.) This suggests that the resolution of imprecision is very much mediated by a robust Outgroup effect, such that the Persona factor is maximally influential when the speaker’s identity diverges from that of the participant. Before further discussing the implications of this result, however, an important caveat concerning the interpretation of this finding is in order. While participants were directly asked to rate themselves along Nerdiness and Chillness (see §3.3.), the characters of Arthur and Alex were never explicitly associated with these two dimensions. As a result, the interpretation suggested above crucially rests on the assumption that participants’ self-ascribed judgments can be successfully linked to the Personae represented by the characters of Arthur and Alex respectively. We believe that, in light of the results of our norming study and the logic of our experimental design, this assumption is largely justified; however, it is important to point out that a certain amount of uncertainty remains around the underlying relationship between respondents’ self-evaluation and respondents’ evaluation of the speaker – and in particular about whether participants’ interpreted questions on Nerdiness and Chillness as specific inquiries about their identification with the stereotypical personae embodied by the character they saw, or as more generic assessments about their own personality and character.

That said, to the extent that the Ingroup vs. Outgroup effect can be construed as indicative of an effect of the relation of participants’ identity to that of the speaker, this result enriches our perspective on how identity considerations affect pragmatic processing. In particular, it points to the need to go beyond considering speaker identity in isolation, in line with the perspective-dependent nature of social meanings already widely theorized in sociolinguistic research: speaker identity effects on interpretation – and thus the relationship between social meaning and semantics and pragmatics – are indeed shown to crucially depend on the listeners’ own positioning with respect to the relevant identity categories. What remains to be explained is why, in our particular case, persona effects are enhanced in the Outgroup condition, as opposed to the Ingroup one. While further research is needed to fully address this, we offer two possible interpretations compatible with our findings here, which provide different ways of of differentiating the impact of the stereotypical associations with the speaker personae in play based on how the participant relates to them.
One possibility is that participants can generally and readily access (consciously or unconsciously) the stereotypical association between a particular persona and the relative social expectations as they perform the task, but vary in how this affects their response choices. For example, respondents identifying themselves as nerdy might have been reluctant to respond in a way that would have contributed to confirming – and possibly reinforcing – a negative stereotype of them as exceedingly detail oriented and scarcely attuned to flexible pragmatic behavior. By the same token, respondents identifying themselves as chill might have been refusing to behave in a way that would have indexed themselves as sloppy or not particularly articulate (see Beltrama 2018a for further discussion of the negative and positive traits indexed by precise speech in relationship to numerical expression). In contrast, in the Outgroup conditions, participants would have lower stakes in the identity construction game, and thus be more susceptible to let these stereotypes impact their behavior – and ultimately their responses.

An alternative possibility might be that there is variation in how accessible the relevant indexical associations between persona and precision are, such that relevant stereotypical properties of the speaker’s persona are more salient and accessible to language users that do not identify with that persona. On this view, when a Nerdy speaker’s utterances are assessed by a nerdy participant, or a Chill speaker’s by a chill participant, the pertinent stereotypical associations don’t really enter the picture (or do so to a lesser extent), simply because their cognitive salience to the participant is decreased (or altogether non-existent). In contrast, when the speaker’s and the participant’s identity do not align, these associations may stand out more prominently, perhaps reflecting a general tendency to rely more heavily on stereotypical notions when considering the behavior of people that are different from us.

While the response choice data reported above does not allow us to differentiate between these possibilities, investigating the unfolding process of participants’ decision-making over time, possibly using more fine-grained methods such as visual world eye-tracking, may help tease them apart. For example, if the participants’ pragmatic reasoning in an Ingroup configuration involves a step of initially considering relevant indexical associations, and a subsequent step of discarding them for purposes of settling on a response, this could be reflected in an overall longer response time course, as well as discernible behavioral patterns along the way, e.g., in terms of different eye movement trajectories between the visual representations of the response options, compared to when the indexical associations are not discarded or not entering the picture at all. Formulating more full-fledged predictions and adapting the paradigm as needed will obviously require more work, which we have to leave for a future occasion. But we think that these initial considerations already make clear both how much more there is to be explored about the interplay of social meaning and semantics and pragmatics, as well as what crucial additional insights might result from utilizing psycho-linguistic methods that can further our understanding of the cognitive processes involved in juggling these dimensions in the overall interpretation process.

Looking at the broader picture, and regardless of the specific explanation behind the effect observed in the experiment, we think it is clear that there is much to gain from better understanding what role comprehenders’ identity and perspective play in the overall interpretation process. We see this endeavor as theoretically important for two reasons. From a methodological perspective, it highlights the importance of better understanding how social or ideological differences between participants could shape the outcome of experimental tasks – including in studies in which social information is not part of the object of investigation, and thus neither manipulated nor controlled for. While most work in experimental pragmatics has proceeded under the assumption that identity-
level differences between participants should not affect the outcome of pragmatic reasoning in connection to phenomena such as scalar implicatures, our findings suggest that, when the resolution of meaning is at stake, tracking and incorporating such differences into can yield insights on experimental results that would not have been available otherwise. From a theoretical perspective, advancing our understanding of the role of participants’ identity, and its relation to the speaker’s identity, in utterance interpretation would allow for a more systematic incorporation of the notions of the speakers’ and listeners’ perspectives, as well as their relation to one another, in pragmatic and semantic theory. While sociolinguistic theory has systematically highlighted the inherently relational and interactional nature of social meanings (see §2.1 for further discussion), most work on pragmatic reasoning is primarily taking into account the speaker’s perspective, anchoring utterance interpretation primarily in the speaker’s communicative intention, and largely neglecting the listener’s perspective and identity, and their relation to the speaker’s. That said, there are, of course, lines of work where the role of the speaker-hearer relationship for utterance interpretation plays a central role already, e.g., in accounts of semantic phenomena that inherently track the relative status and/or epistemic perspective of the interlocutors – e.g., honorifics (McCready 2019); demonstratives and indexicals (Lakoff 1974; Bowdle and Ward 1995; Acton 2014); verum operators (Romero and Han 2004); and subjective predicates (Kölbel 2002; Lasersohn 2005; Stojanovic 2007). However, the finding that participants’ positioning is an important factor determining the resolution of imprecision points to a broader, more general way in which the listener’s stance could shape pragmatic reasoning and, ultimately, utterance interpretation above and beyond such phenomena that more or less inherently invoke both discourse participant’s perspectives. This, in turn, highlights the importance of developing pragmatic models that adequately reflects the dynamics of alignment (or lack thereof) between the speaker and the listener in conversation – an endeavor that has recently been spear-headed in work at the interface of pragmatics and sociolinguistics (see in particular Burnett 2017, 2019), and which could be further informed by findings collected via paradigms such as the one used in our studies.

Adopting a broader view of the relation between speaker and hearer identity for utterance interpretation, the present findings also have potential broader social relevance for domains that go well beyond the resolution of imprecision. An especially important concern revolves around how identity considerations affect epistemic dimensions of meaning that are bound to carry heavy implications in different realms of social life for speakers – e.g., the degree of confidence or authority ascribed to speakers in a particular context, or the willingness or attentiveness that an interlocutor might apply towards parsing the message communicated by a speaker. This question has already garnered considerable attention in research on testimonial injustice in philosophy, both in connection to instances of credibility deficit — the act of failing to treat someone seriously as a source of knowledge on the basis of their social identity (Fricker 2007) — and credibility excess – the act of ascribing inflated expertise to an interlocutor, again based on identity-based expectations (Davis 2016). Relatedly, recent work on the quality of courtroom transcripts for speech by speakers of African American English revealed substantial decreases in transcription accuracy in official records based on dialect differences between speakers and transcribers (Jones et al. 2019). The types of differences in speaker identity at play in our study may be more subtle and comparatively less fraught, but of course many other stereotypes, including ones associated with specific dialect variants, are likely to have comparable effects. We believe that linguistic research along the lines of the work that we presented could be highly relevant to shedding further light on these issues – and in particular to enriching our critical understanding of how bias, prejudice and other identity-
related effects on meaning interpretation arise and develop in the course of a conversation. Our present approach, of course, merely scratches the surface of all this, but we hope that it opens up new directions in understanding the foundations of how social meanings in general, and the relation between social identities of the discourse participants in particular, can impact what a given utterance is ultimately taken to convey in context.

6 Conclusion

In two sets of studies we showed that the social persona embodied by the speaker, as well as participants’ own alignment with respect to this persona, crucially impacts the precision with which numerical expressions are interpreted. Taken together, we believe that these findings open up a novel angle on the study at the interface of semantics, pragmatics and sociolinguistics, highlighting the importance of further exploring the interaction between these dimensions of meaning in future research.
Appendix

Each version of the experiments can be accessed online via the following link:

- Experiment 1, Nerd: https://farm.pcibex.net/r/ZJRPUr/
- Experiment 1, Chill: https://farm.pcibex.net/r/gjXFwu/
- Experiment 2, Nerd: https://farm.pcibex.net/r/GNaWvW/
- Experiment 2, Chill: https://farm.pcibex.net/r/qPPzHV/

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