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Case Report

How verbal-nonverbal consistency shapes the truth

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ABSTRACT

The experience of fluency, or subjective ease, has a robust effect on human judgment, including the extent to which a fluently processed stimulus is perceived as true, familiar, or attractive. Evidence that fluently processed messages are perceived as true has primarily focused on written text or object images while much of human communication occurs when people can both see and hear each other. As such, little is known about the characteristics of communication that lead to an emergent sense of fluency in an *interpersonal* context. We propose that the consistency of a senders' verbal and nonverbal behavior, or *communicative coherence,* facilitates the integration of information across communicative modalities and thus the fluency of speech comprehension. By this mechanism, we expect communicative coherence to shape perceptions of truth. Consistent with our hypotheses, we find that senders' verbal-nonverbal consistency increased perceivers' comprehension fluency, leading them to accept the sender's message as true (Study 1). Further, we use an audio-video off-set procedure to manipulate communicative coherence, and find that audio-video offset caused perceivers to doubt the truthfulness of a message (Study 2). That is, senders' communicative coherence appears to *cause* perceivers to evaluate messages as truthful. Findings extend a rich literature on the effects of processing fluency by pointing toward the importance of understanding the antecedents of processing fluency in interpersonal contexts typical to human history.

For most of human history, people have been able to see and hear each other when they communicate. Prior to the invention of the printing press, people rarely perceived language absent facial, bodily, and vocal qualities that convey emphasis, emotion, attitudes, confidence and so on (DePaulo & Friedman, 1998; Knapp, Hall, & Horgan, 2014). Humans appear to have adapted to these conditions, such that speech comprehension is understood as the product of psychological processes that integrate nonverbal and verbal aspects of communication (Cassell, McNeill, & McCullough, 1999; Hostetter, 2011). As a consequence, the ease or *fluency* with which perceivers integrate a sender's verbal and nonverbal behavior in comprehending a message might influence their evaluations of that message. Previous research has established that processing fluency has a robust impact on the extent to which people evaluate information as true, familiar, frequent, or attractive (Bornstein, 1989; Dechêne, Stahl, Hansen, & Wänke, 2010; Jacoby, Woloshyn, & Kelley, 1989; Reber & Schwarz, 1999; Reber, Schwarz, & Winkielman, 2004; Westerman, Lanska, & Olds, 2015). However, investigations into the effects of processing fluency have focused on judgments of text (e.g., Jacoby et al., 1989; Reber & Schwarz, 1999), abstract concepts (e.g., Schwarz et al., 1991), and neutral images (e.g., Monahan, Murphy, & Zajonc, 2000; Reber, Winkielman, & Schwarz, 1998; Weisbuch, Mackie, & Garcia-Marques, 2003). As such, little is known about how processing fluency operates within the verbal-nonverbal context that has historically characterized human communication. We identify a novel verbal-nonverbal phenomenon that has consequences for interpersonal interactions—*communicative coherence*. We expect this aspect of sender demeanor to increase perceivers' processing fluency and their judgments of senders as truthful.

1. Multi-modal integration and processing fluency

Communicative coherence is the degree to which verbal and nonverbal information convey consistent information in interpersonal communication; we expect such coherence to influence the ease with which perceivers comprehend a sender's message. Indeed, it is well known that speech comprehension is multi-modal, meaning that both auditory and visual information is integrated to aid the listener's understanding of speech (e.g., Kelly, Özyürek, & Maris, 2010; McGurk & MacDonald, 1976). In most cases, integration across multiple channels appears to increase the listener's ability to accurately represent the phonemes, sounds, and statements produced by the speaker. In a classic study, for example, Sumby and Pollack (1954) found that listeners'

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speech comprehension was improved if they could not only hear, but also see the speaker. Other research suggests that attention to the mouth, in particular, can aid speech comprehension (Rosenblum, Johnson, & Saldana, 1996). However, the benefits of observing a speaker's nonverbal behavior during verbal communication is not limited to 'reading lips'. For example, there is evidence that observing natural head movements can improve speech comprehension (Munhall, Jones, Callan, Kuratate, & Vatikiotis-Bateson, 2004) and listeners who follow a speaker's eye movements are more likely to understand what is said (Richardson & Dale, 2005).

There is also evidence that hand gestures produced by the speaker can facilitate listeners' speech comprehension when those gestures are coordinated with speech in time and meaning. Such gestures are common and spontaneous occurrences, particularly in face-to-face dialogue (e.g., Bavelas, Gerwing, Sutton, & Prevost, 2008; Krauss, Dushay, Chen, & Rauscher, 1995). These gestures appear to aid both the speaker, in speech production (Krauss & Hadar, 1999), as well as the listener, in speech comprehension. For example, several studies suggest that speakers use their head and eyebrows to stress certain words in their sentences and perceivers determine which word in a sentence is receiving emphatic stress by perceiving these head and brow movements (e.g., Bernstein, Eberhardt, & Demorest, 1998; Thompson, 1934). Other research indicates that perceivers can use those head and face gestures to discriminate statements from questions (e.g., Bernstein et al., 1998; Bernstein, Demorest, & Tucker, 2000). Hand gestures, too, seem to be particularly beneficial to listeners who are second-language learners or children (vs. adults), when those gestures convey information that is not redundant with speech content, and when those gestures convey physical (vs. abstract) information (Hostetter, 2011; Sueyoshi & Hardison, 2005). For example, Graham and Argyle (1975) found that listeners reproduced line drawings more accurately when speakers, who described the drawings, were permitted to use hand gestures versus when speakers were not.

There are, however, some situations in which the human tendency to integrate across modalities can hamper the processing and comprehension of speech. There is considerable evidence that accuracy in speech perception and comprehension decreases when the various channels of communication provide inconsistent information. In a dramatic example of this effect, McGurk and MacDonald (1976) showed participants videos of people producing a phoneme (/ba-ba/), dubbed with the sound of a different phoneme (/ga-ga/). The integration of these two inconsistent channels produced the perception of a third, different phoneme that was never spoken (/da-da/)—an error in speech comprehension. Incongruent hand gestures too, can hamper speech comprehension. For example, research by Kelly et al. (2010) found that participants responded more slowly and made more errors in response to stimuli that contained incongruent verbal and nonverbal behavior (e.g., video of a person saying "chop" while making a 'twist' hand gesture) than congruent information (e.g., saying "chop" while making a 'chop' hand gesture). In summary, evidence from a variety of methodological paradigms suggests that the nonverbal context of interpersonal communication typically aids comprehension of a verbal message but that it can also hamper comprehension.

We expect communicative coherence to account, in part, for variability in the effects of nonverbal context on speech comprehension. In general, findings suggest that multi-modal aspects of speech are integrated to make sense of a speaker's message and that, to the extent that these aspects are consistent, comprehension will be more fluent: easier, faster, and less prone to error. By contrast, then, inconsistency across verbal and nonverbal channels (communicative *in*coherence) is likely to require more time and effort to integrate and understand, decreasing processing fluency.

2. Communicative coherence and truth judgments

We expect the metacognitive experience of fluency associated with comprehending a message will critically depend on the ease or difficulty involved in integrating information across sensory modalities, and—consistent with fluency attribution models—that this experience will be spontaneously attributed to a salient cause in the environment (Jacoby et al., 1989; Schwarz et al., 1991; Unkelbach & Greifeneder, 2013; Weisbuch & Mackie, 2009). People have intuitions about likely causes of fluency, and for most people, fluency is reasonably attributed to the familiarity, frequency, truth, perceptual clarity, or attractiveness of a stimulus. Accordingly, perceivers judge fluently-processed stimuli to be familiar, frequent, true, perceptible, and attractive (Bornstein, 1989; Jacoby et al., 1989; Reber & Schwarz, 1999; Reber et al., 2004; Westerman et al., 2015; Whittlesea, Jacoby, & Girard, 1990; Witherspoon & Allan, 1985). Thus, we expect communicative coherence to elicit processing fluency during speech comprehension by virtue of perceptual and cognitive integration processes and we expect such fluency to increase the perceived truth of a message.

The fundamental role of verbal-nonverbal integration in speech comprehension has yet to be applied to understanding deception detection. The paucity of such research is particularly striking given that a very large literature has documented how each of many verbal and nonverbal behaviors—in isolation—might be (a) a valid cue to deception and/or (b) used by perceivers to infer deception (DePaulo et al., 2003; Hartwig & Bond, 2011). Importantly, very little (if any) research has examined how different types of cues might interact to inform deception detection. Instead, the constellation of cues that characterize a given sender during communication have been studied as a higher-order individual-difference variable—demeanor (Goffman, 1956). Indeed, research by Levine et al. (2011) suggests that demeanor is a primary driver of truth and lie judgments, even if these behaviors are not reliable cues to deception (e.g., DePaulo et al., 2003). We extend the long tradition of studying effects of demeanor in the deception detection literature by identifying an emergent aspect of behavior—the consistency of verbal and nonverbal meaning—likely to affect veracity judgments. Critically, we identify processing fluency as a mediator of this effect.

3. Current research

In a pair of studies, we operationalize communicative coherence and examine whether this characteristic of interpersonal communication increases the perceiver's ease of speech comprehension and their judgments of the sender's veracity. Specifically, we hypothesize that when verbal and nonverbal behavior convey consistent information—in other words, display communicative coherence—perceivers will experience fluency in speech comprehension. Put differently, when senders convey different information between verbal and nonverbal channels, the inherent difficulty of integrating these disparate sources of information will result in a metacognitive experience of disfluency. Further, to the extent that a message is characterized by communicative coherence, perceivers will judge it as truthful (vs. deceptive). As some of the first studies on communicative coherence, an important goal of the current work is to provide converging evidence for these phenomena. In Study 1, we measure sender variability in communicative coherence and use this measure to predict perceivers' experiences of comprehension fluency and judgments of truth. In Study 2, we experimentally manipulate communicative coherence through an audio-video offset procedure to examine the causal influence of such coherence on perceiver fluency and judgment. In these studies, we report all measures, manipulations, and exclusions.

4. Study 1

Using a large database of truthful and deceptive messages, we measure communicative coherence and processing fluency, and use these measures to predict judgments of truth. Specifically, we aim to establish that communicative coherence can be reliably evaluated.

More importantly, we examined the extent to which our measure of senders' communicative coherence predicted perceivers' ease of understanding a message. We expected perceivers' sense of ease (i.e., comprehension fluency) to mediate the relationship between senders' communicative coherence and perceivers' judgments of truth.

4.1. Method

4.1.1. Participants

Sixty-one undergraduates (47 women, 14 men; 49 White, 4 Latinx, 3 Asian, 2 Native American, 2 mixed-race, 1 Middle-Eastern) at a private university in the American west were recruited in exchange for partial course credit. Sample size was determined prior to data collection and was based on prior evidence for the number of participants necessary to establish good interrater reliability in judgments of video clips. For example, in one of our prior studies (Weisbuch, Slepian, Clarke, Ambady, & Veenstra-Vanderweele, 2010), 16 participant raters achieved good interrater reliability (α's > 0.87) in judging the happiness and sadness of each of 41 persons presented via video. In a different study (Weisbuch, Ambady, Clarke, Achor, & Weele, 2010), 18 participant raters achieved good interrater reliability (α = 0.80) in judging the likability of each of 40 persons presented via video. Similar, though slightly lower reliabilities (α's > 0.75) were achieved for the same judgments made on the basis of video transcripts. In other "thin-slice" studies, even fewer participant raters have been used. For example, 9 raters evaluated a wide variety of traits from thin-slice videos of teachers, achieving adequate interrater reliability (α > 0.70) for nearly all traits (Ambady & Rosenthal, 1992). In fact, adequate interrater reliability has been achieved with as few as 3–4 raters in prior studies on deception detection (e.g., DePaulo, Rosenthal, Green, & Rosenkrantz, 1982) or on "thin-slices" (e.g., Murphy et al., 2015). Collectively, the evidence from our own and others' prior studies made us confident that we could achieve good interrater reliability with sample sizes of 14–20 raters (for videos) and slightly larger sample sizes for ratings of transcripts (given the slightly lower reliabilities in prior research).

4.1.2. Materials

The Miami University Deception Detection Database (MU3D; Lloyd et al., 2019) provided the video materials for this study. The MU3D includes 320 videos drawn from 80 "senders" who each made 4 videos. Each sender was videotaped as they described 4 different target persons (one video per target), claiming to like a target person in two videos and claiming to dislike a target person in two other videos. Only half of these videos (per sender) were truthful—the other half were deceptive (e.g., describing a disliked person as liked). From these videos, we selected two videos from each of the 40 White senders, for a total of 80 videos. In both selected videos, the sender claims to like the target person. For each sender, one video was truthful and one was deceptive.[1] Each video was approximately 40 s long.

The MU3D includes a normed database for the frequency with which each video was regarded as truthful or deceptive, translated into probabilities. We used this metric as the outcome variable in Study 1, reflecting the probability that the message in the video was regarded as truthful during norming (M = 0.61, SD = 0.17). Additionally, MU3D provided transcriptions of each video.

4.1.3. Design and procedure

Participants completed one of three procedures, contingent on their experimental condition. Participants provided ratings either of: communicative coherence, comprehension fluency of video-based messages, or comprehension fluency of understanding transcript-based messages.[2] Specifically, fourteen participants watched each (randomly-ordered) video and evaluated the extent to which the sender's "visible behavior was inconsistent with what they said aloud" on a 7 point scale (from "strongly disagree" to "strongly agree"). Participant raters exhibited acceptable interrater reliability, α = 0.90. We thus computed a composite inconsistency score by averaging across coders and then reverse-scored this measure to more intuitively reflect *communicative coherence* (M = 4.83, SD = 1.18).

Another group of 17 participants watched each (randomly-ordered) video and evaluated how easy it was to understand each sender as an index of comprehension fluency ("the speaker described their friend in a way that was easy for me to understand"; agreement 1–7). A third group of 30 participants made the same evaluation but on the basis of (randomly-ordered) transcripts; we anticipated lower reliability among raters in transcript ratings (Weisbuch, Slepian, et al., 2010), and thus oversampled transcript raters. Participant raters exhibited acceptable interrater reliability in their comprehension fluency ratings from videos (α = 0.77) and transcripts (α = 0.89). For each type of comprehension fluency, we computed a composite score for each sender by averaging across coders, with means and standard deviations reported in the Results section.

4.2. Results

4.2.1. Preliminary analyses

There was considerable variability in communicative coherence scores. Although most scores were above the midpoint of the coherence scale ("4"), 36% were below the midpoint, and scores ranged from 1.57 to 6.57 (SD = 1.15). Although not central to our goals, we evaluated the relationship between the *actual* veracity of each message and communicative coherence. Actually-true messages did not significantly differ from actually-false messages in communicative coherence [M_{True} = 4.31, SD_{True} = 1.09; M_{False} = 4.10, SD_{False} = 1.22], t(76) = 1.24, p = .22. The same was true for comprehension fluency of videos, t(76) = 0.91, p = .36, and comprehension fluency of transcripts, t(76) = 0.10, p = .92. However, messages that were actually-true were more likely to be evaluated as true (M = 65%) than were actually-false messages (M = 56%) in this set of videos, t(76) = 2.29, p = .025. For each of these analyses, we had 80% power to detect an effect size of d = 0.65. Importantly, the analyses reported below do not change when we account for the actual veracity of the message. As such, actual veracity will not be discussed in what follows.

4.2.2. Communicative coherence and comprehension

We hypothesized that senders' communicative coherence would facilitate perceivers' experiences of comprehension fluency. Indeed, communicative coherence scores were significantly associated with comprehension fluency for videotaped messages, r (76) = 0.29, p = .009: as communicative coherence increased so too did comprehension fluency. This analysis, and the correlational analyses that follow, had 80% power to detect an effect size of r = 0.38.

One possible explanation for this effect, contrary to our theory, is that comprehension fluency is based strictly on the verbal content of the message. By this account, the relationship between comprehension fluency and communicative coherence might occur because senders who generate easy-to-comprehend verbal content are also more likely to match their nonverbal behavior to this content. To test this alternative account, we examined the correlation between communicative coherence and comprehension fluency for transcripts. However,

[1] Experimenter error resulted in two "dislike" videos being included in the study. These two videos were dropped from analyses because the speaker described a person they did not like. As such, analyses include ratings of 78 videos.

[2] We also collected comprehension fluency of audio-based messages, using a separate sample of participants, as part of a larger project. As these data are not pertinent to our hypotheses; they are not presented here.

communicative coherence scores were not significantly correlated with comprehension fluency for transcript-based messages, r (76) = −0.03, p = .79.

Our theory is based, in part, on the idea that nonverbal behaviors typically enhance comprehension fluency (Sumby & Pollack, 1954). Indeed, comprehension fluency was significantly higher for messages presented via video (including nonverbal behavior; M = 4.95, SD = 0.65) than identical messages presented via transcript (M = 4.66, SD = 0.81), t (77) = 3.41, p = .001.[3] This analysis had 80% power to detect an effect size of d = 0.32.

The inclusion of nonverbal channels does not *always* enhance comprehension fluency (e.g., Kelly, Ozyurek, & Maris, 2010; McGurk & MacDonald, 1976), as noted earlier. We hypothesized that nonverbal channels enhance perceivers' comprehension fluency to the degree that messages are delivered with communicative coherence. To test this hypothesis, we first calculated a difference score to index the degree to which the addition of nonverbal channels facilitated or detracted from comprehension fluency. These differences were computed as video comprehension fluency minus transcript comprehension fluency. As illustrated by Fig. 1, most but not all messages elicited higher comprehension fluency when nonverbal channels were available (video) than when they were not (transcripts). More importantly, nonverbal channels enhanced perceivers' comprehension fluency to the degree that a message was delivered with communicative coherence, r (76) = 0.22, p = .055 (see Fig. 2). In short, communicative coherence might help explain why nonverbal behavior sometimes does and sometimes doesn't facilitate fluent comprehension of a message.

4.2.3. Communicative coherence and truth judgments

Our primary hypothesis was that perceivers would base their truth judgments on senders' communicative coherence. As hypothesized, communicative coherence scores positively and significantly predicted truth judgments provided in the MU3D norm database, r (76) = 0.34, p = .002.

We further hypothesized that this relationship would be mediated by perceivers' experiences of comprehension fluency. Specifically, we theorized that communicative coherence would increase comprehension fluency of video-based messages, and that such fluency subsequently causes perceivers to evaluate those messages as truthful. Although we recognize limitations to mediational analyses (Fiedler, Harris, & Schott, 2018), we sought to test this hypothesis using PROCESS (Hayes, 2013) to examine the indirect effect of communicative coherence on perceived truth *through* message comprehension (see Fig. 3). The bootstrapped unstandardized indirect effect testing the mediating role of fluent comprehension (i.e., coherence➔ comprehension➔truth judgment) was 0.018, and the 95% confidence interval did not cross 0 (95% CI: 0.0032, 0.0373). While this result does not preclude the existence of other mediating relationships (Fiedler et al., 2018), this indirect effect is consistent with the hypothesis that senders' communicative coherence influenced perceivers' truth judgments *through* perceivers' fluent comprehension.

4.2.4. Comprehension and truth judgments

Prior research has established that fluent comprehension of a text-based statement causes perceivers to identify those messages as true (e.g., Unkelbach & Greifender, 2013). Consistent with this prior work, and the mediational model presented above, perceivers' fluent comprehension of video-based messages significantly predicted the likelihood that those messages would be evaluated as true, r (76) = 0.45, p < .001. There is an important caveat, however. Comprehension fluency for transcripts of the same messages had a weak, only marginally significant, association with truth judgments, r (76) = 0.20, p = .08. In short, we illustrate that the relationship between comprehension fluency and judged-truth may be modality-specific.

[3] That said, comprehension fluency via video was positively correlated with comprehension fluency via transcripts, r (76) = 0.48, p < .001. Participants were not ignoring verbal content in their experiences of comprehension fluency.

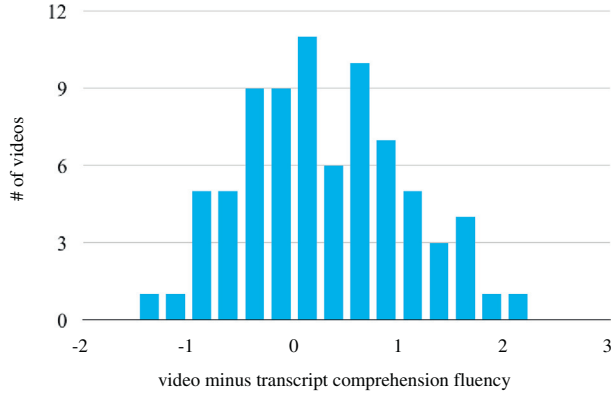

Fig. 1. Histogram illustrating variability in video minus transcript comprehension fluency. Scores above 0 indicate that video and the availability of verbal-nonverbal behavior increased comprehension fluency over comprehension fluency of (the same) transcript-based message.

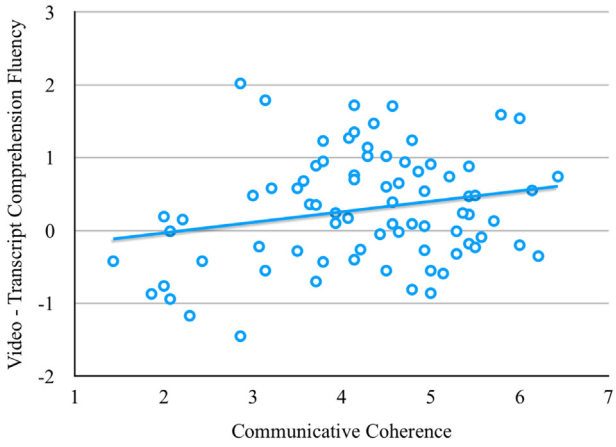

Fig. 2. Scatterplot and line of best fit indicating the relationship between communicative coherence and the difference between video and transcript comprehension fluency. Positive correlation indicates that communicative coherence is positively associated with the extent to which video (and access to nonverbal behavior) increases comprehension fluency over simply reading a transcript.

4.3. Discussion

We identified communicative coherence as a characteristic of verbal-nonverbal behavior that varies naturally across individuals and messages. While access to nonverbal behavior generally improved comprehension, this effect was not universal. To the extent that verbal and nonverbal behavior conveyed consistent information, comprehension fluency was improved. Further, communicative coherence was associated with the presumed truth of a message and this effect was mediated by the fluent comprehension of the video-based message. In contrast, comprehension fluency of transcripts was not significantly related to the likelihood that the same video-based message would be judged as truthful. This suggests that verbal-nonverbal consistency is associated with the ease of understanding a message and this sense of fluency cannot be accounted for by ease of understanding text alone. In short, we identified a novel predictor of fluency and perceived truth that is unique to interpersonal (face-to-face or video) communications.

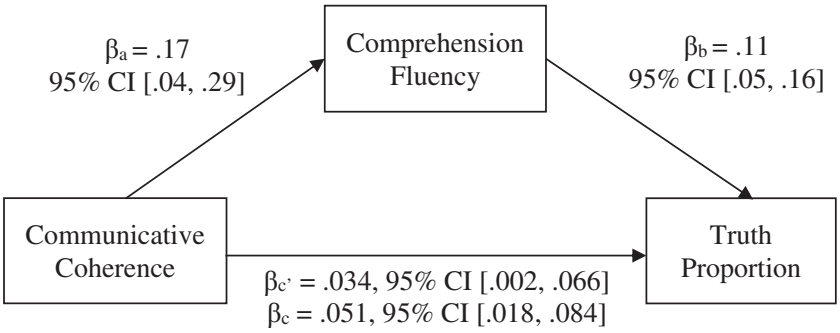

Fig. 3. Mediation model of the effect of communicative coherence on the proportion of observers who rated the speaker as truthful, through comprehension fluency (Study 1). The model depicts point estimates and 95% percentile-bootstrap CI for each estimate.

5. Study 2

Although Study 1 highlighted the relationship between communicative coherence and perceptions of truth, the correlational nature of this study did not establish this relationship as causal in nature. We set out to examine causality in Study 2 by experimentally manipulating communicative coherence. Specifically, we used a temporal offset procedure such that the verbal and nonverbal channels were aligned versus misaligned. This manipulation has the benefit of affecting only the consistency across channels and not the content within channels. We predicted that aligned videos would be judged as truthful more than misaligned videos.

5.1. Participants

An a priori power analysis suggested that a sample size of 109 would be required to detect a small to medium effect of communicative coherence on veracity judgments (Cohen's $d = 0.35$) when setting power at 0.95 and alpha at 0.05. One hundred and seven participants (58 women, 48 men, 1 did not provide gender information) were recruited through Amazon's Mechanical Turk. Self-reports of racial categories indicated that 80 participants were White, 10 were Black, 8 were Asian, and 9 were Latinx. Interquartile range of age was 27 to 39 ($M = 34.8$, $SD = 9.4$).

For the purposes of data analysis, we excluded 2 participants who failed at least half of the attention checks on videos and 10 participants who failed the instructions attention check (see Procedure for details), leaving a total sample size of 95. No additional participants were sampled after initial data analysis.

5.2. Materials

We selected 24 videos (12 women, 12 men; ½ truthful, ½ deceptive) used in Study 1 for editing. Apart from veracity and gender, selection criteria for Study 2 were aimed at eliminating measurement artifacts. To encourage participants to make independent judgments of different video clips, we selected only one video clip (either truth *or* lie) per sender. To limit floor or ceiling effects for any given clip, we only selected those clips that were identified as truths by > 35% and < 65% (i.e., 50% ± 15%) of raters in the MU3D norm database (Lloyd et al., 2019). Communicative coherence scores for these videos ($M = 4.38$, $SD = 1.01$) were near the midpoint of the communicative coherence scale. Each of these twenty-four videos were edited so that the audio channel was offset by 600 msec after the video channel. Thus, there were a total of 48 videos used in Study 2, including the 24 originals (*aligned*) and the 24 offset (*misaligned*). Videos thus conveyed the same information *within* verbal and nonverbal channels but the temporal consistency of the information differed *between* channels so that it was greater in the aligned versus misaligned condition. Accordingly, audio-video offset represented our manipulation of communicative coherence. We then created two sets of 24 videos. Each set included 12 aligned videos and 12 misaligned videos. The only difference between the two sets of videos was that the videos which were aligned in Set A were misaligned in Set B, and vice-versa.

5.3. Procedure

Participants were randomly assigned to evaluate the 24 videos in Set A or the 24 videos in Set B. After completing informed consent, they were instructed that after each video, they would use a 6-point scale (from "definitely lying" to "definitely telling the truth") to respond to the following question: "Was this person lying or telling the truth about liking the other individual?" Because this study was conducted online we were concerned that some participants might fail to read or follow instructions. Accordingly, as participants were reading the instructions, we directed participants to respond "none" to a 4-choice item querying how they were completing the study (laptop, desktop, phone, *none*). For this same reason, we were concerned that some participants may fail to attend to the content of each video. Thus, in addition to the 24 videos participants evaluated for truthfulness, they also watched videos from three new senders that we edited so that they could serve as video attention checks. For each of these three videos, we superimposed a large capitalized neutral word (THERE, REST, GOING) over the face of the sender for 10s. After each video concluded, participants were simply asked to report the word that appeared on the screen. The order of the 24 critical videos were randomized for each participant, and the video attention checks appeared at regular intervals among these 24 videos. After evaluating all 24 videos and all 3 video attention checks, participants provided demographic information, were debriefed, and then thanked and dismissed.

5.4. Results

As hypothesized, truth ratings were higher for aligned videos ($M = 3.79$, $SD = 0.53$) than for misaligned videos ($M = 3.63$, $SD = 0.60$), $t(94) = 2.91$, $p = .01$, Cohen's $d = 0.25$.[4] This analysis had 80% power to detect an effect size of $d = 0.37$. Note that inclusion of the 12 "excluded" participants does not alter this pattern of results nor the statistical significance of this relationship.

[4] We also conducted a 2 (communicative coherence: aligned, delayed) x 2 (counterbalancing: video set 1, video set 2) ANOVA on truth judgments with repeated measures on the first factor. Consistent with hypotheses, and the *t*-test presented in text, there was a significant main effect of communicative coherence, $F(1, 93) = 6.81$, $p = .01$, *Cohen's* $d = 0.58$. The effect of counterbalancing condition approached significance, $F(1, 93) = 3.91$, $p = .051$, *Cohen's* $d = 0.28$, though the interaction with aligned vs. delayed did not ($p = .13$).

5.5. Discussion

We identify an experimental manipulation of communicative coherence that isolates verbal-nonverbal consistency. Using this temporal manipulation, we observed that a manipulation of senders' communicative coherence influenced communicative fluency and judgments of truth, supporting our hypothesis that such coherence *causes* perceivers to evaluate messages as truthful.

One limitation of this study is that we did not measure whether comprehension fluency was influenced by the alignment manipulation. We thus conducted a post-test to examine if—as expected—aligned (versus misaligned) videos elicited greater comprehension fluency from perceivers. Specifically, twenty Mechanical Turk workers (11 males, 9 females; M_{age} = 38.15, SD_{age} = 15.40) were recruited to rate the communicative coherence of the aligned and misaligned videos, as a manipulation check. Participants completed a procedure identical to the main study (including attention checks and counterbalancing) but instead of evaluating the truthfulness of each video, they used a 7-point scale (from "strongly disagree" to "strongly agree") to respond to the following statement: "The speaker described their friend in a way that was easy for me to understand." Two manipulation-check participants were excluded because they failed two or more of the video attention checks (n = 1) or failed the instruction attention check (n = 1). More importantly, and as expected, comprehension fluency was greater for aligned (M = 5.00; SD = 0.67) versus misaligned (M = 4.59; SD = 0.65) videos, $t(17) = 2.81$, $p = .012$.

6. General discussion

Prior research on processing fluency has relied on written names, written statements, or static images (for review, see Unkelbach & Greifender, 2013), yet historically, most human communication required perceivers to integrate verbal and nonverbal sources of information. Consistent with the historical context of human communication, we found evidence in support of the theory that perceivers' metacognitive experiences of fluency during speech comprehension depends on the ease of integrating information across modalities. Consequently, we argued that this metacognitive experience of fluency would influence the degree to which perceivers' regard a message as truthful. As predicted, consistency in the information conveyed between senders' verbal and nonverbal behavior influenced perceivers' felt sense of fluency in speech comprehension. Further, consistency in the information conveyed by senders' verbal and nonverbal behavior influenced perceivers' acceptance of a message as true. Finally, comprehension fluency mediated the relationship between senders' communicative coherence and perceivers' truth judgments; communicative coherence increased the perceivers' sense of fluency in speech comprehension and this effect increased the likelihood that a message will be judged as truthful. Thus, while the presence of a nonverbal channel generally increased fluent comprehension of verbal information, this effect depended on the extent to which the channels conveyed consistent information. These findings converge with previous research focused on written communication (e.g., Jacoby et al., 1989; Reber & Schwarz, 1999) and suggest that effects of fluency on perceptions of truth extend to face-to-face (and video) interactions *through* processing efforts in integrating information across modalities.

These findings are best conceptualized as proof-of-concept for a new theory of processing fluency in interpersonal communication, but also point to new directions for research in deception detection. Our theory suggests that the judgmental consequences of comprehension fluency are moderated by the communicative context in which fluency occurs. Whereas prior research suggested that text-based statements that are more fluently understood are more likely to be regarded as true, we argued that fluency in face-to-face or video contexts is a product of processing mechanisms that integrate information across processing channels and can therefore not be reduced to evaluations of verbal content. Indeed, in Study 1, truth judgments were significantly predicted by the fluency with which perceivers' comprehended multichannel speech, but not by the extent to which perceivers comprehended (the same) verbal information from text (i.e., transcripts). Ease of video comprehension was, in turn, predicted by the extent to which senders conveyed similar information across verbal and nonverbal channels. Our theory of communicative coherence thereby suggests that fluency is an emergent phenomenon that is best examined in the communicative contexts in which the judgmental effects of fluency are expected to generalize: easy-to-comprehend verbal content may not have a direct effect on truth judgments in the face-to-face interactions that characterized most of human history. By the same token, this theory is clearly in keeping with extant theory and research on processing fluency; we theorized and observed that fluent processing yielded judgments of truth. Instead, our theory and findings highlight the importance of understanding the processes and contexts that produce fluency in the first place.

There is clearly much more to learn about the role of processing fluency in interpersonal communication, and especially how people evaluate deception in such contexts. First, our theory was broad—owing to the absence of research on communicative coherence in processing fluency and deception detection—and did not aim to identify the specific cues that contributed most strongly to fluent comprehension in interpersonal contexts. However, prior research points to several types of cross-channel consistencies in communication that are likely to be important to perceivers ease of comprehension, and thus to truth judgments. For example, semantic emphasis can be conveyed nonverbally (e.g., eyebrow gestures, head gestures, and hand movements) and verbally (e.g., "In particular", "Importantly," "The biggest issue"); alignment of these cues may influence the ease with which perceivers comprehend a speaker. Relatedly, prior research suggests that the presence of hand gestures and facial expressions assist second-language learners in comprehending spoken English (Sueyoshi & Hardison, 2005). A second example suggested by extant research includes the consistency between hand gestures meant to illustrate physical and spatial properties of an object and verbal descriptions of the physical and spatial properties of those objects (e.g., Kelly et al., 2010). Finally, the consistency of nonverbal emotion expressions with verbal emotional prosody improves the recognition of emotional facial expressions (Dolan, Morris, & de Gelder, 2001; Massaro & Egan, 1996) and may similarly influence comprehension fluency of the prosodic language. Future research could isolate these specific behaviors to determine how they contribute to the broader phenomenon studied here. Additionally, we have focused on comprehension fluency—how easily participants understood what the sender was saying. However, there are many sources of fluent (or disfluent) experiences, many of which do not require multi-modal integration (Alter & Oppenheimer, 2009). Accordingly, future research could examine the role of nonverbal behavior in isolation on this meta-cogntive experience. Even in the absence of speech to comprehend, bizarre or halted hand gestures may also give rise to disfluency, leading to similar effects on the perceived truthfulness of communication.

Additionally, future research should consider the cognitive processes by which communicative coherence affects the acceptance of information as true; this relationship may occur through multiple pathways, as predicted by the elaboration likelihood model (Petty & Cacioppo, 1986). Within this framework, the experience of processing fluency is regarded as a cue that can play multiple roles, depending on the receivers' level of elaboration (Briñol, Tormala, & Petty, 2013). For example, in low elaboration contexts the fluency attribution hypothesis (e.g., Jacoby et al., 1989; Weisbuch & Mackie, 2009) is thought to hold, and likely accounts for the effects observed here as perceivers evaluated many videos in succession—perceivers experienced fluency and then attributed it to the main dimension they were evaluating (truthfulness). However, when receivers are motivated and able to engage in high elaboration processes, the experience of fluency may have an indirect

effect on judgments of truth and agreement by (a) biasing thoughts in a positive direction, and (b) increasing confidence in the thoughts generated (Briñol et al., 2013). Finally, when elaboration is unconstrained, the fluency caused by observing communicative coherence may increase the likelihood of low elaboration processing whereas communicative incoherence and disfluency will tip perceivers toward high elaboration processing of the message (e.g., Alter, Oppenheimer, Epley, & Eyre, 2007; Song & Schwarz, 2008). Additional research will be necessary to uncover the mechanisms underlying truth judgments of communicatively coherent messages at various levels of elaboration.

Finally, although the context for the laboratory-created statements studied here are limited in scope, the effects of communicative coherence seem likely to extend to more consequential contexts like political discourse. Indeed, research suggests that politicians' appearance and behavior can influence voter decisions (e.g., Druckman, 2012; Todorov, Mandisodza, Goren, & Hall, 2005), and their communicative styles can affect the support they receive from fellow lawmakers (ten Brinke, Liu, Keltner, & Srivastava, 2016). That is, verbal and nonverbal behavior contribute to the proliferation of ideas that come to make up a nations' laws. Future research should examine whether communicative coherence can account for the perceived truth and persuasiveness of political communications, demonstrating that the phenomenon we have identified in the lab translates to more consequential contexts.

6.1. Summary

Human communication has, for much of history, occurred only in face-to-face contexts. In this context, nonverbal behavior has played an important role in the comprehension of verbal messages. We identify communicative coherence as a source of fluency that is fundamental to effective human communication. Specifically, we find that verbal-nonverbal consistency increases the ease of understanding a sender's message and causes receivers to identify statements as true, ultimately shaping our knowledge, beliefs, and shared reality.

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