



The Continuous Expression of Emotional and Helpful Behavior During High-Stake Deception: 911 Homicide Calls

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Abstract

The current study investigated the continuous behaviors of deceptive and honest individuals calling 911 to report a homicide. Using the Continuous Assessment of Interpersonal Dynamics (CAID) methodology, judges coded the stream of emotional and helpful behaviors expressed by 911 callers ($n = 82$). Consistent with past models of deception, deceptive 911 callers tended to express higher levels of mean emotional behavior and lower levels of mean helpful behavior than honest callers. Additionally, deceptive callers' emotional behavior increased, and their helpful behavior decreased during the call at greater trajectories than honest callers.

Keywords 911 calls · Deception · Homicide investigations · Open data · Preregistered

Introduction

DISPATCHER: 911, what is your emergency?

CALLER: Hello? Look, you gotta help, man. My girlfriend's [unintelligible] in the bathroom. She can't breathe air. I mean, like...oh my god, man. She's gonna die, man. Come on. [unintelligible] Please.

DISPATCHER: I can barely understand. Calm down.

CALLER: Please. [sobbing] Oh my god. She was drinking and like...I don't know what happened. I know she went to the bathroom, and when I went there, she was...it was there...was floor...blood and everything like...like...I don't know, man. She's not breathing. She's gonna f#%&\$*g die, man. Come on. Send the [unintelligible] right here, right now, man.

DISPATCHER: What is the address?

CALLER: [sobbing] I don't know. I just smoked my cigarette, man.

DISPATCHER: You need to give me the address so we can get her some help.

CALLER: [sobbing] Maria, come on, baby, please. Don't f#%&\$*g...don't die, baby. Come on.

The above transcript begins a 911 call that came into the Broward County Sheriff's Office at 3:39 am on September 20, 2016. The caller's initial emotional behavior escalated during the 911 call, and by the end of the call, the caller's crying and uncontrollable sobs made him nearly unintelligible. During the nearly 3-min exchange and subsequent police investigation, the caller claimed that he had discovered his girlfriend bleeding and having trouble breathing after he returned from smoking a cigarette. While the caller initially claimed to be unaware of what had happened to his girlfriend, it would later be discovered that the caller, Fidel Lopez, had murdered his girlfriend when she called out her ex-husband's name during sex with Lopez (Farrell 2017).

The public, law enforcement, and attorneys often securitize the behavior exhibited by 911 callers when speculating about a caller's deception during a call. For example, some law enforcement officers and researchers have suggested that callers, such as Fidel Lopez, whose voices are filled with emotion, change in pitch, volume, and tone are likely being deceptive (c.f., Miller et al. 2021), whereas others have suggested that callers who lack emotion or have a "robotic tone" during a 911 call are deceptive (c.f., Harpster 2006; Harpster et al. 2009). The public and legal speculation concerning the various meanings of behaviors expressed by 911 callers reporting homicides illustrates the need for a better understanding of which behaviors are related to deception and how these behaviors might change during a 911 call. Therefore, the current research had two primary aims. First,

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we examined whether the expressions and changes in behaviors of 911 callers across the duration of their call could be used to predict caller deception. Second, we utilized a well-validated method, applied to the novel domain of deception detection, for continuously assessing the behaviors of 911 callers.

Deceptive Behaviors in Low and High Stake Environments

Numerous studies have examined various behaviors that are related to deception. Often these studies are conducted by asking individuals to make either honest or deceptive claims regarding relatively low-stakes topics in a laboratory setting. The behaviors of these deceptive or honest individuals are recorded and later coded by judges using a multitude of scales. For example, past studies asked individuals to lie about their feelings concerning controversial topics (e.g., capital punishment), deceive judges as to the content of a photograph, mislead others about their academic accomplishments, or even lie about the suit of a playing card (e.g., Heinrich and Borkenau 1998; Cheng and Broadhurst 2005; Riggio and Friedman 1983). Based on these studies, one large-scale meta-analysis found that deceptive individuals tend to be nervous, tense, uncooperative, and tell unconvincing narratives that lack logic (DePaulo et al. 2003).

There are theoretical and empirical reasons to suspect that deception-related behaviors will be more pronounced during 911 homicide calls than in the low-stakes situations these past studies tended to examine. First, behaviors related to deception may become more evident when people lie about serious transgressions (e.g., committing a homicide) than mundane issues (Miller and Stiff 1993). Second, high-stake interactions are typically accompanied by strong emotions that are difficult to fake (Porter and ten Brinke 2010). Third, 911 calls are usually placed soon after a crime, giving deceptive individuals little time to create and rehearse a false narrative (Harpster et al. 2009). Finally, a person who has committed homicide is unlikely to know how an innocent person would typically behave when calling 911 (Markey et al. 2022).

Harpster and colleagues (Harpster 2006) conducted one of the earliest systematic attempts to examine behaviors related to caller deception during 911 homicide calls.¹ In this study, 20 behaviors were related to the deception or honesty of 911 homicide callers. Deceptive callers tended to be uncooperative, blamed the victim for the situation, and gave conflicting facts to the 911 operator. On the other

hand, honest callers were more likely to make demanding and urgent pleas while sounding emotional.

The results from the Harpster study need to be considered in light of its limitations. First, the primary author seems to have coded the 911 calls. Because this judge also “personally contacted” each lead detective to obtain the 911 calls, it is unclear whether this judge was unaware of the guilt or innocence of the callers (Harpster 2006). Additionally, subsequent attempts at replicating the findings from Harpster and colleagues have consistently failed to reproduce most of their results (c.f., Cromer et al. 2019; Miller et al. 2021). In order to overcome the limitations of the Harpster study, Markey et al. (2022) recently examined a sample of 911 homicide calls to gain insight into which behaviors are valid indicators of deception. This study employed a group of judges, blind to whether the caller was being deceptive, to code 86 different behaviors. Results indicated that deceptive 911 callers were self-dramatizing, overwhelmed, worried, and related narratives that lacked structure, clarity, and focus. Whereas honest callers were forthright, candid, focused, cooperative, and provided a coherent sequence of events.

These previous findings illustrate that deception research conducted in the laboratory and past 911 research has examined a variety of informative behaviors. However, theoretical models and empirical data suggest that behaviors related to the overarching constructs of emotionality and helpfulness might be particularly salient for examining deception within the context of 911 calls. For example, various models of deception suggest that the disconnect between a deceiver’s narrative and reality causes the leakage of emotional behavior (Zuckerman et al. 1981; Ekman 1992; DePaulo 1992). Consistent with this reasoning, and as discussed earlier, laboratory and 911 research have found that deceptive individuals appear to be overwhelmed, upset, anxious, and nervous. In comparison, honest individuals are relatively calm (DePaulo et al. 2003; Markey et al. 2022). Beyond this disconnect with reality, deceivers express emotional behavior, especially in high-stake situations, when they are concerned, their dishonesty will be discovered (Ekman 1992).

In addition to emotional behavior, it has also been postulated that deceivers are likely to display behaviors related to being unhelpful, less forthcoming, and uncooperative (Zuckerman et al. 1981; Ekman 1992; DePaulo 1992). This speculation is primarily based on the notion that because deceivers have to fabricate a narrative, they do not usually have the same command of the relevant facts as honest individuals who can straightforwardly discuss the situation. This increased cognitive load and uncertainty experienced by deceptive individuals will cause them to tell less than compelling narratives and appear uncooperative as they attempt to make up details, keep the false details consistent, and keep track of what they have said. Consistent with this rationale, past laboratory and 911 research have found that deceptive

¹ Harpster et al. (2009) report the same data and results as those reported in Harpster (2006) and are discussed here as a single study.

individuals tend to be unhelpful, hindering, less than forthcoming, evasive, and tell narratives that lack structure and clarity (DePaulo et al. 2003; Markey et al. 2022). Within the unique context of 911 homicide calls, honest individuals are particularly motivated to be as cooperative and helpful as possible with the dispatcher in order to obtain a quicker response from emergency services.

Trajectories of Deceptive Versus Honest Behavior

One major limitation across 911 deception research is that all past studies have focused exclusively on mean levels of behaviors exhibited by deceptive persons. For example, Markey et al. (2022) coded 911 calls by having judges rate behaviors after listening to each call based on how characteristic or uncharacteristic a given behavior was of the caller. Although this methodology is informative as to a caller's behavior on average, it neglects to consider that individuals often alter their behavior during an interaction (Markey et al. 2010). In other words, while deceptive callers are generally more overwhelmed and uncooperative than honest callers (Markey et al. 2022), it is unclear whether this difference becomes more or less pronounced across the phone call. The current research aims to address this gap in the existing literature.

Consistent with the notion that behaviors likely vary across time during the act of deception, Buller and Burgoon (1996) argued that deceivers adapt and change their behaviors as they continually monitor the target of their deception for signs of suspicion. These authors speculated that deception is relatively difficult at the beginning of an interaction, but these “difficulties should typically dissipate over time as participants acquire more feedback,” causing deceivers to become calmer and more relaxed as the interaction continues (Buller and Burgoon 1996, p. 220). Contrary to this expectation, research conducted primarily in laboratories has found that behaviors related to stress and tension increase with increasing interactivity (DePaulo et al. 2003). Such findings might occur because, as deceivers' interactivity with another person increases, it becomes more cognitively challenging for them to appear honest while trying to ensure their false narratives appear plausible, consistent with known facts, and coherent with fabricated details. It has further been speculated that this cognitive challenge is more pronounced when the deceiver finds themselves in an unfamiliar situation (e.g., a 911 homicide call) than during more familiar forms of communication (e.g., talking to an acquaintance; DePaulo et al. 2003). It, therefore, seems likely that during a 911 call, behaviors related to deception will become more apparent as the call proceeds.

The Continuous Assessment of Emotional and Helpful Behavior

Past research examining deception during both low- and high-stake interactions shows that emotional and helpful behavior are essential variables to assess when examining deception. Having identified the variables on which to focus, the next task involves assessing the variation of these behaviors during a 911 call. The current study used the Continuous Assessment of Interpersonal Dynamics (CAID; Sadler et al. 2009) tool to provide continuous measurements of emotional and helpful behavior during a 911 call. The CAID technique has been used extensively in previous research in other domains where researchers continuously tracked behaviors during interpersonal interactions (c.f., Fox et al. 2021; Meisel et al. 2021). For the current study, a CAID assessment was made by judges simultaneously listening to a 911 call and using a computer joystick to code a given caller's emotional and helpful behavior (details of this procedure are presented in the methods section). Using this assessment methodology, judges' codes were recorded every .5 s. Mean levels of emotional and helpful behavior can be calculated from the codes across the interaction. However, the novel contribution of this technique is that it allows the recordings taken every .5 s to be chronologically organized, illustrating how emotional and helpful behavior changed during the 911 call. Figure 1 presents example behavioral profiles from two 911 callers coded for the current study.

The deceptive individual in this example (Caller ID#82709) had placed a call to 911 to report that he had witnessed home invaders strangle his wife. Contrary to the caller's claim, it was later learned that the caller was deceptive during the call after being found guilty of killing his wife. The honest individual in this example (Caller ID#02878) called 911 to report finding a relative's lifeless body. It was later discovered that this caller was being honest after home invaders were convicted of the murder. While both calls displayed in Fig. 1 lasted approximately 250 s, these calls displayed dramatically different emotional and helpful behavior patterns. Specifically, the deceptive caller became more emotional as the call progressed, whereas the honest caller became less overly emotional. In contrast, the deceptive caller's helpfulness decreased during the call, while the honest caller's helpfulness linearly increased during the 250 s.

These two examples can also be used to illustrate how both the general level of emotional and helpful behavior and the changes in these behaviors can be examined using CAID data. Simple means can be computed for each caller, indicating how generally emotional and helpful the caller was during the 911 call. As might be expected

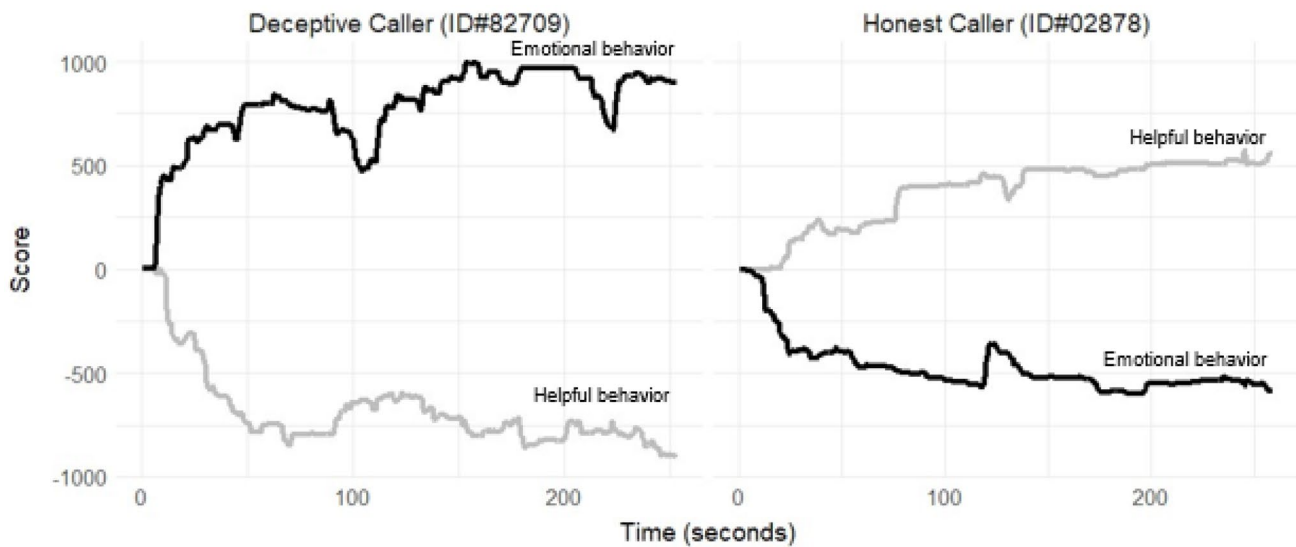


Fig. 1 Example of emotion and help behavioral profiles from a deceptive 911 caller (left) and an honest caller (right)

from previous research, the deceptive caller in this example was, on average, both more emotional (M emotional behavior = 779.66) and less helpful (M helpful behavior = -681.91) than the honest caller (M emotional behavior = -473.23; M helpful behavior = 368.38). Regression analyses for each time series can derive slopes that index the overall change in these behaviors during the call. For example, as might be predicted, the deceptive caller's emotional behavior displayed a linear increase ($b = 1.91$) during the call. In other words, for every second of the call, the deceptive caller's emotional behavior increased, on average, 1.91 units. In contrast, during the call, the honest caller's emotional behaviors decreased linearly ($b = -1.82$). Furthermore, while the deceptive caller's helpful behavior decreased during the call ($b = -1.21$), the honest caller's helpful behavior increased ($b = 1.95$) during the same time frame. Of course, these two example callers provide no more than a bit of illustrative information. A larger sample of 911 calls is needed to examine these trends more dependably, and analyses sensitive to the hierarchical structure of these data (e.g., multilevel modeling) need to be employed to better understand these observed changes in emotional and helpful behavior.

The Current Research

The current study's overarching goals were to investigate both mean levels and trajectories of continuous behaviors of deceptive and honest individuals calling 911 to report a homicide using a sensitive and well-validated methodo-

logical approach. Using a sample of 911 homicide calls collected previously by Markey et al. (2022), we asked judges using the CAID methodology to provide continuous assessments of emotional and helpful behavior during these high-stakes calls. This study's research hypotheses, methodology, and analytic plans were preregistered on OSF before the 911 calls were coded using the CAID procedure (<https://osf.io/grke9>). The data for the study have also been made publicly available on OSF (<https://osf.io/kpwj7/>). The preregistration for this study discussed two primary hypotheses and two secondary hypotheses.

Primary Hypotheses 1 and 2

Consistent with past research that has found deceptive individuals tend to be overly emotional and unhelpful, it was predicted that deceptive 911 callers would express higher levels of mean emotional behavior (Hypothesis 1) and lower levels of mean helpful behavior (Hypothesis 2) than honest callers.

Secondary Hypotheses 3 and 4

Consistent with the notion that the cognitive challenges associated with deception tend to become more difficult across time, it was predicted that deceptive callers' emotional behavior would increase (Hypothesis 3) and their helpful behavior would decrease (Hypothesis 4) during the call at a greater rate than honest callers.

Method

Data and Sources

Consistent with prior 911 research (Cromer et al. 2019; Miller et al. 2021), calls were obtained from publicly available open-source data, such as news sources, police department releases, and various archives. Calls placed to 911 were eligible for the study using similar criteria employed by past researchers (c.f., Cromer et al. 2019; Burns and Moffitt 2014). (1) The call involved the killing of another person. (2) Emergency services were notified. (3) The caller was aware of and able to communicate the general nature of the emergency. (4) At least two news sources could verify prosecution, admission of guilt, or another outcome ultimately resulting from the call. (5) The call was less than 7 min in length. (6) The caller did not confess to wrongdoing. Callers claiming extenuating circumstances (e.g., self-defense, accident, etc.) that led to the death of another person were included.

Based on a priori power, a sample size of 82 (41 deceptive callers and 41 honest callers) for the primary hypotheses was necessary to achieve 80% power for a moderate effect size ($r_{pb} = .30$). The 911 calls used in the current study were randomly selected from the data set previously examined by Markey et al. 2022 investigating cue validity. This previous research did not examine changes in behaviors across the course of a 911 call and did not utilize the CAID coding methodology employed in the current study.

Determination of 911 Callers' Deception

At least two external sources (usually media reports detailing the crime's legal proceedings) were used to determine callers' deception or honesty. To be coded as "deceptive," the caller was required to have been found guilty in a court of law. In cases when an indictment was not possible, such as the death of the caller, expert opinions were employed (e.g., opinion of the medical examiner, police investigators, grand jury findings, etc.). The remaining callers not deemed guilty were coded as "honest." This coding method is consistent with past 911 research (Cromer et al. 2019; Miller et al. 2021; Markey et al. 2022).

Behavioral Coding Procedure

Callers' behaviors were coded by three judges using the CAID methodology (CAID; Sadler et al. 2009), which provides an ongoing assessment of behavior. As discussed earlier, the CAID uses a joystick tracking device in which the judges manipulate a joystick while listening to a call to represent a caller's ongoing behavior. CAID data were scaled

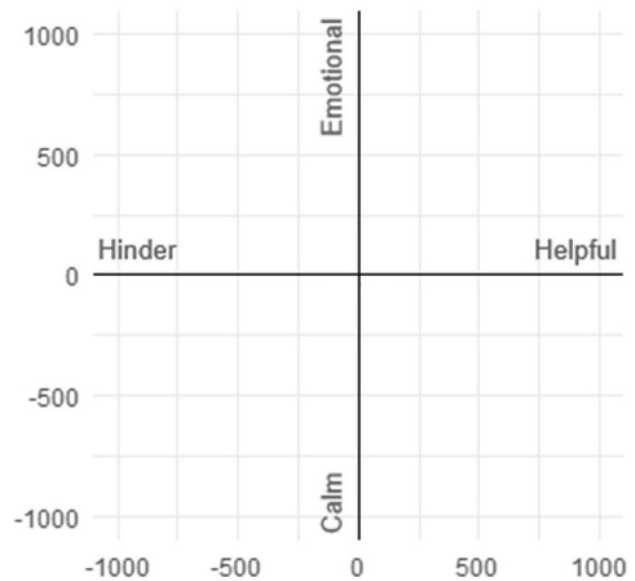
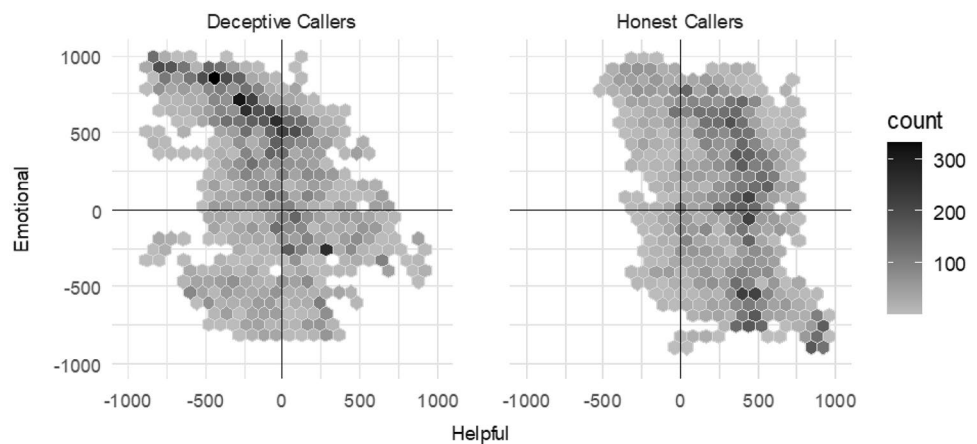


Fig. 2 CAID dimensions used to code callers' behaviors during 911 homicide calls

from -1000 to 1000 on both dimensions, with 1000 on the y-axis representing extreme emotional behavior and 1000 on the x-axis representing extreme helpful behavior (see Fig. 2). Specifically, along the y-dimension, the caller's behavior was coded as high on emotion when the caller appeared overwhelmed, extremely upset, moody, or nervous. Whereas the caller's behavior was coded low on emotion when the caller acted relatively calm given the situation (e.g., they might be upset but seem to be coping with the stress of the situation), appeared stable, composed, or expressed low affect. Along the x-dimension, the caller's behavior was coded as helpful when the caller appeared to help the victim (e.g., performing CPR), provided helpful information to the operator (e.g., discussed relevant details about the situation), was candid, or cooperative. In contrast, the caller's behavior was coded as low on helpfulness when the caller did not provide helpful or relevant information to the operator, did not aid the victim, was evasive, uncooperative, or hindering.

Judges coded the behaviors of 911 callers as they listened to the call by moving the joystick in any direction to represent how emotional or helpful a caller was behaving at a given time. For example, if the caller behaved emotionally but only moderately helpfully, the judge would move the joystick to the right. If the caller started acting more helpful and was still emotional, the judge would move the joystick up and to the right. The joystick was also sensitive to how strongly it was being pushed in a specific direction. For example, a judge could code a caller as acting somewhat emotionally by lightly pushing the joystick up; if the caller started acting more emotionally, the judge could push the joystick further in this direction. Judges were instructed to

Fig. 3 Density scatter plots expressed as hexagonal bins summarizing the frequency of .5 s behavioral codes from deceptive and honest 911 callers



keep the joystick in approximately the same position during short silences in the call unless the silence was suggestive of a change in the caller's emotional or helpful behavior (Markey et al. 2010). A miniature version of the Cartesian plane seen in Fig. 2 was also displayed on the lower right side of the video screen to provide judges with visual feedback about the current position of the joystick. The computer program DARMA (Girard and Wright 2018) was used to numerically record the joystick's location at .5 s intervals for the entire call.

After being trained on the CAID methodology, judges practiced using the joystick tracking device to code 5 practice 911 calls. The researchers monitored the judges' performances, and questions about using the joystick tracking device were discussed as they arose. After judges felt comfortable using the CAID methodology, each judge coded the 84 calls examined in the current study. Calls were presented to judges in the same random order, and calls were coded separately by judges. Judge agreement was assessed using intraclass correlations (ICC; two-way random effects, consistency; McGraw and Wong 1996; Koo and Li 2016). The average judge reliability was .76 for emotional and .70 for helpful behavior. Because of the acceptable judge agreement, the helpfulness and emotional codes were aggregated by computing the average judge score at each time point for each call.

Results

Because the CAID methodology recorded 911 caller behavior every .5 s, there were a total of 34,711 emotional and helpful behavioral codes. Consistent with past CAID research, the first 10 data points for each call were deleted to allow raters 5 s to orient themselves to the call and provide enough time for the caller to speak (c.f., Sadler et al. 2009). Figure 3 displays the frequency of these codes for honest and deceptive callers. As can be seen in these figures,

both honest and deceptive callers displayed behaviors that were sometimes helpful and unhelpful and behaviors that were emotional and unemotional. However, the location and frequency of these behaviors suggest that deceptive callers tended to display more emotional and less helpful behavior than honest callers.

The mean emotional and helpful behavior observations for each 911 call were computed to examine this issue more closely. Figure 4 displays a scatter plot of individual caller means and the overall means of the 41 honest and the 41 deceptive callers. Consistent with Hypothesis 1, it was found that deceptive callers displayed higher levels of mean emotional behavior ($M = 231.01$, $SD = 459.34$) than honest callers ($M = -2.71$; $SD = 467.84$; $t(80) = -2.28$, $p = .02$, $r_{pb} = .25$).

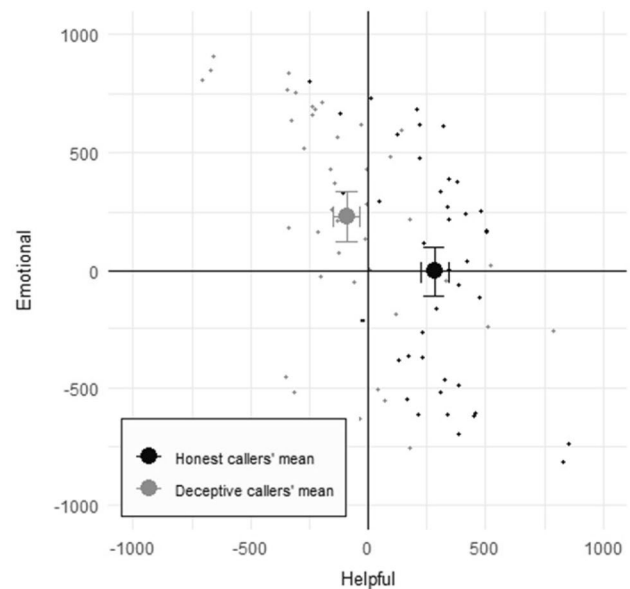


Fig. 4 Scatter plot of the mean emotional and helpful behavior displayed by 911 deceptive and honest callers. Small icons indicate the mean of individual 911 callers, and large icons indicate the overall mean of honest and deceptive callers with 95% confidence intervals

Table 1 Summary of multilevel models predicting 911 callers' emotional and helpful behavior

Dimension	Parameter	Coefficient	CI	<i>t</i> -ratio (df = 80)	<i>P</i>
Emotional	Intercept (γ_{00})	-2.69	-138.12–132.72	-0.04	.97
	Deception of caller (γ_{01})	233.73	42.21–425.25	2.39	.02
	Time (γ_{10})	-0.67	-1.61–0.27	-1.40	.17
	Time X deception of caller (γ_{11})	1.71	0.39–3.04	2.54	.01
Helpful	Intercept (γ_{00})	284.05	206.73–361.37	7.20	<.001
	Deception of caller (γ_{01})	-377.31	-486.67– -267.97	-6.76	<.001
	Time (γ_{10})	0.83	-0.54–2.20	1.19	.24
	Time X deception of caller (γ_{11})	-2.16	-4.10– -0.22	-2.18	.03

Further, as predicted by Hypothesis 2, deceptive callers displayed lower levels of mean helpful behavior ($M = -93.20$, $SD = 293.56$) than honest callers ($M = 284.03$, $SD = 211.19$; $t(80) = 6.67$, $p < .001$, $r_{pb} = .59$).

To examine whether deceptive callers' emotional behavior increased at a higher rate than honest callers (Hypothesis 3), multilevel modeling (MLM) was used with time (level 1) nested within caller (level 2). This two-level model used the predictors of both time (caller centered) and caller deception (coded 0 = caller was honest and 1 = caller was deceptive) in the equations:

Level 1 model

$$\text{Emotional behavior}_{ij} = \beta_{0j} + \beta_{1j} * (\text{Time}_{ij}) + r_{ij}$$

Level 2 model

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (\text{Caller deception}_j) + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11} * (\text{Caller deception}_j) + u_{1j}$$

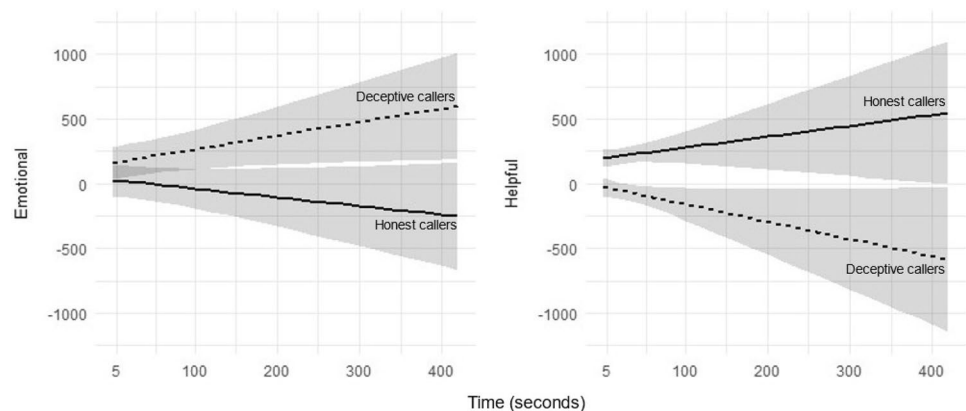
with time i and caller j . Because the variable time was centered and caller deception was dummy coded, the coefficient γ_{00} represents the mean emotional behavior of honest callers, and γ_{01} is the mean difference between honest and deceptive callers. Similarly, γ_{10} represents the slope for honest callers indicating the change in emotional behavior for each second

increase in time, and γ_{11} is the cross-level interaction and represents the difference in this slope between honest and deceptive callers.

As seen in Table 1 and consistent with the previous analysis, deceptive callers tended to display, on average, more emotional behavior ($\gamma_{01} = 233.73$, $SE = 97.71$, $t(80) = 2.39$, $p = .02$) than honest callers. More central to Hypothesis 3, the coefficients from this analysis indicate that honest callers' emotional behavior *decreased* an average of $-.67$ (γ_{10}) units each second, whereas deceptive callers' emotional behavior *increased* an average of 1.04 ($\gamma_{11} + \gamma_{10}$) units each second. This difference in slopes for honest and deceptive callers was significant ($\gamma_{11} = 1.71$, $SE = .68$, $t(80) = 2.54$, $p = .01$). Hypothesis 4 was examined using a similar model. Similar to the previous analysis, deceptive callers tended to display, on average, less helpful behavior ($\gamma_{01} = -377.31$, $SE = 55.79$, $t(80) = -6.76$, $p < .001$) than honest callers. More importantly for Hypothesis 4, honest callers helpful behavior *increased* an average of $.83$ (γ_{10}) units each second, whereas deceptive callers helpful behavior *decreased* an average of -1.33 ($\gamma_{11} + \gamma_{10}$) units each second, and this difference was significant ($\gamma_{11} = -2.16$, $SE = .99$, $t(80) = -2.18$, $p = .03$).

To better understand how callers' deceptiveness moderated the effect of time on emotional and helpful behavior, graphical representations of the obtained cross-level

Fig. 5 Cross-level two-way interaction effect for emotional (left) and helpful (right) behaviors. The 95% confidence interval of the regression lines are displayed as shaded confidence bands



interactions were created (see Fig. 5), which were derived using the uncentered time variable in the two-level MLM. The slopes presented in these figures reflect the predicted change in emotional and helpful behavior for deceptive and honest callers.

Discussion

Law enforcement officers report that they often evaluate the related 911 call when investigating a homicide (Opanashuk et al. 2022). These calls provide a valuable starting point as the first statements from potential witnesses for an investigation and give insight into the circumstances surrounding the reporting of the homicide. In addition to providing such information, the current research suggests that by examining a 911 caller's emotional and helpful behavior, law enforcement might gain insight into the deception of the caller. Specifically, the current research examined continuous ratings of 911 callers' behaviors to determine whether the extent and trajectories of their emotionality and helpfulness would predict deception.

Consistent with Hypotheses 1 and 2, deceptive callers tended to behave more emotional and less helpful, on average, than honest callers. These findings conform with past theories of deception, which speculate that the disconnect between a deceiver's narrative and their fear of their dishonesty being discovered will cause the leakage of emotional behavior (Zuckerman et al. 1981; Ekman 1992; DePaulo 1992). Likewise, these models surmise that the cognitive complexity and uncertainty inherent when creating a false narrative will cause deceivers to tell unhelpful narratives which are less forthcoming and less compelling (Zuckerman et al. 1981; Ekman 1992; DePaulo 1992). The current study's findings are also consistent with past empirical research, which found that deceptive individuals tend to appear emotional (e.g., overwhelmed, upset, anxious, nervous) and unhelpful (e.g., hindering, less than forthcoming, evasive; DePaulo et al. 2003; Markey et al. 2022).

While the findings concerning average levels of helpfulness are similar to past deception research, no study had previously examined how changes in these behaviors might indicate deception during 911 calls. This oversight was unfortunate because, as DePaulo et al. (2003) noted, as the interactivity with another person increases, it likely becomes more cognitively challenging for deceivers to appear truthful while making sure their false narratives are coherent, consistent, and plausible. Therefore, the current study hypothesized that behaviors related to deception would become more apparent as the call proceeded. Consistent with the study's hypotheses, it was found that deceptive callers' emotional behavior increased (Hypothesis 3), and their helpful

behavior decreased (Hypothesis 4) during the call at a greater rate than honest callers.

These findings suggest that emotional and helpful behavior are related to deception, *and* the differences in the expression of these behaviors by honest and deceptive callers become greater toward the end of 911 calls. This point is graphically illustrated in Fig. 5, which shows how the small second-by-second changes in emotional and helpful behavior during a 911 call become magnified as the call proceeds. For example, by applying the equations used to create this figure, after the first 5 s of a call placed to 911, honest and deceptive callers' emotional behavior is only predicted to be different by about 141 units; however, after 400 s, this difference increases 480% to 816 units. Similarly, honest and deceptive callers' helpful behavior is only predicted to differ by about 234 units after 5 s; however, after 400 s, this difference increases 365% to 1087 units. Therefore, individuals attempting to determine the possible deception of 911 callers would be wise to pay particular attention to the behaviors expressed by callers near the end of 911 calls.

Although the current study found that emotional and helpful behavior are related to 911 callers' deception, caution is warranted for anyone basing a caller's guilt or innocence solely on behaviors expressed during a 911 call. Such information might help law enforcement identify people and areas of interest, but it would be a mistake to use it to make a definitive conclusion concerning criminal activity. Additionally, results from the current study should be considered within its limitations. Because archival 911 calls were used, there was no transparent chain of custody for these calls. Therefore, it is unknown whether some calls were edited (e.g., names might have been deleted for privacy reasons). The generalizability of these results might be limited as some states do not release 911 calls to the public, and all calls were from English speakers. Future researchers might consider obtaining calls directly from law enforcement or examining calls from a more diverse geographic area.

Another important limitation is that the current study operationalized deception based on whether a 911 homicide caller, who did not confess to wrongdoing during the call, was later convicted of the homicide. While this operationalization is consistent with past 911 research (c.f., Cromer et al. 2019; Miller et al. 2021), given the imperfect nature of the criminal justice system, caution is warranted when using criminal conviction as a proxy assessment for deception. Finally, the current study only focused on 911 homicide calls. It is hoped that others will employ the CAID methodology presented here to examine the continuous display of emotional and helpful behavior in other high-risk criminal situations such as missing persons, aggravated assault, or arson.

Declarations

Ethical Approval The current study employed an observational method and was approved by the university research ethics board. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Conflict of Interest The authors declare no competing interests.

References

- Buller DB, Burgoon JK (1996) Interpersonal deception theory. *Commun Theory* 6:203–242
- Burns MB, Moffitt KC (2014) Automated deception detection of 911 call transcripts. *Secur Inform* 3:1–9
- Cheng KHW, Broadhurst R (2005) The detection of deception: the effects of first and second language on lie detection ability. *Psychiatry Psychol Law* 12:107–118
- Cromer JD, Brewster J, Fogler K, Stoloff M (2019) 911 Calls in homicide cases: what does the verbal behavior of the caller reveal? *J Police Crim Psychol* 34(2):156–164
- DePaulo BM (1992) Nonverbal behavior and self-presentation. *Psychol Bull* 111:203–243
- DePaulo BM, Lindsay JJ, Malone BE, Muhlenbruck L, Charlton K, Cooper H (2003) Cues to deception. *Psychol Bull* 129:74–118
- Ekman P (1992) *Telling lies: Clues to deceit in the marketplace, politics, and marriage*. W.W. Norton. (Original work published 1985)
- Farrell J (2017) Man who ripped out girlfriend's intestines for yelling her husband's name during sex gets life in prison. *The Independent*. <https://www.independent.co.uk/news/world/americas/man-girlfriend-intestines-fidel-lopez-yell-husband-name-sex-florida-sunrise-maria-nemeth-life-sentence-prison-a7876251.html>. Accessed 20 Aug 2017
- Fox SE, Thomas KM, Durbin CE, Hopwood CJ (2021) A variance decomposition of the continuous Assessment of Interpersonal Dynamics. *Psychol Assess* 33:427–442
- Girard JM, Wright AGC (2018) DARMA: software for dual axis rating and media annotation. *Behav Res Methods* 50:902–909
- Harpster T, Adams SH, Jarvis JP (2009) Analyzing 911 homicide calls for indicators of guilt or innocence: an exploratory analysis. *Homicide Stud* 13:69–93
- Harpster TK (2006) *The nature of 911 homicide calls: using 911 homicide calls to identify indicators of innocence and guilt* [Master's thesis, University of Cincinnati]
- Heinrich CU, Borkenau P (1998) Deception and deception detection: the role of cross-modal inconsistency. *J Pers* 66:687–712
- Koo TK, Li MY (2016) A guideline of selecting and reporting intra-class correlation coefficients for reliability research. *J Chiropr Med* 15:155–163
- Markey PM, Feeney E, Berry B, Hopkins L, Creedon I (2022) Deception cues during high-risk situations: 911 homicide calls. *Psychol Sci*
- Markey PM, Lowmaster S, Eichler W (2010) A real-time assessment of interpersonal complementarity. *Pers Relat* 17:13–25
- McGraw KO, Wong SP (1996) Forming inferences about some intra-class correlation coefficients. *Psychol Methods* 1:30
- Meisel SN, Colder CR, Hopwood CJ (2021) Assessing parent-adolescent substance use discussions using the continuous assessment of interpersonal dynamics. *J Pers Assess* 1–13
- Miller GR, Stiff JB (1993) *Deceptive communication*. Sage Publications, Inc
- Miller ML, Merola MA, Opanashuk L, Robins CJ, Chancellor AS, Craun SW (2021) “911 What’s your emergency?”: deception in 911 homicide and homicide staged as suicide calls. *Homicide Stud* 25:256–272
- Opanashuk L, Robins CJ, Merola MA, Craun SW, Miller ML, Chancellor AS (2022) Voice modulation and minimization in 911 homicide calls. *FBI Law Enforcement Bulletin*. <https://leb.fbi.gov/articles/featured-articles/voice-modulation-and-minimization-in-911-homicide-calls>. Accessed 11 Jan 2022
- Porter S, ten Brinke L (2010) The truth about lies: what works in detecting high-stakes deception? *Leg Criminol Psychol* 15:57–75
- Riggio RE, Friedman HS (1983) Individual differences and cues to deception. *J Pers Soc Psychol* 45:899–915
- Sadler P, Ethier N, Gunn GR, Duong D, Woody E (2009) Are we on the same wavelength? Interpersonal complementarity as shared cyclical patterns during interactions. *J Pers Soc Psychol* 97:1005–1020
- Zuckerman M, DePaulo BM, Rosenthal R (1981) Verbal and nonverbal communication of deception. *Adv Exp Soc Psychol* 14:1–59

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