A Voice Inside My Head:

The Psychological and Behavioral Consequences of Auditory Technologies

Abstract

People spend over four hours listening to auditory media daily, providing an important outlet for organizations, marketers, and policymakers to influence behavior. Headphones and speakers are the two most ubiquitous auditory media used. Five experiments demonstrate that because headphones localize sound inside a listener's head (i.e., in-head localization, the sensation that the sound is originating from within one's own head), they increase listeners' felt closeness to the communicators of a message. Consequently, listeners perceive the communicators as warmer, feel and behave more empathically toward them, and are more persuaded by them. Consistent with our theorized mechanism, the difference in felt closeness between headphones and speakers attenuates when headphone listeners hear audio designed to create a "surround sound" experience which reduces the in-head localization of sound. This research sheds light on how, and why, different auditory technologies influence judgments, attitudes, and behaviors.

Keywords: technology; persuasion; immersion; behavior change; communication

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Use of auditory media is at an all-time high (Pew Research Center, 2019). On a typical day, people will hear multiple spoken messages. For example, an individual may listen to a podcast while going for a morning walk, listen to the radio while driving to work, and then stream music throughout the day at the office. In doing so, she may hear a political appeal, a news story about a nonprofit asking for donations, and a public service announcement about the dangers of drinking and driving. Indeed, the advertising market is following this growing trend: in 2022, U.S. radio ad spend is projected to reach $14.8 billion (Forbes, 2021), and U.S. podcast advertising revenue is estimated to reach over $2 billion by 2023 (IAB, 2020).

When listening to an auditory message, people will naturally form judgments about the communicator of the message. If listeners feel a sense of closeness or connection to the communicator, it could impact their response to the message—for instance, they may be more likely to donate their time or money to support the communicator's cause, or be more persuaded by the communicator's message. Advancing prior research that focuses mainly on how the content of a message or the identity of the speaker influences listeners, the current research proposes that it is not only *what or whom* people hear that influences their judgments, decisions, and behaviors, but also *how* they hear the message.

Developments in auditory technologies are fundamentally changing how individuals listen to audio. For instance, a recent survey found that people preferred to listen to non-music content (e.g., podcasts) via some technologies (e.g., phones) more than others (e.g., smart speakers; Rajar, 2020). While evidence suggests different vocal aspects (e.g., accent, gender, vocal qualities) can affect evaluations of a spokesperson or product (Morales, Scott, & Yorkston, 2012; Whipple & McManamon, 2002; Wiener & Chartrand, 2014), little attention has been paid to whether the media through which one hears a voice influences one's psychological and behavioral responses to the message. The two most ubiquitous forms of media currently used to listen to auditory messages are *headphones*—earphones that deliver sound directly into a person's ears—and *speakers*—stand-alone devices that deliver sound into a room. The current work explicates how and why listening to a vocal message via headphones leads to different psychological experiences and responses than listening to the same message via speakers.

Drawing from a wide range of psychology, decision making, and technology literatures, we theorize that listening to a communicator's message through headphones (vs. speakers) will increase feelings of closeness to that communicator. We further predict this increase in felt closeness will lead to three key consequences, making people: (1) perceive the communicator as warmer; (2) feel more empathy for and behave more empathically toward the communicator (e.g., help them); and (3) be more persuaded by the communicator (see Figure 1).

[insert Figure 1 about here]

Auditory Medium and Sound Localization

A primary means by which people connect is through verbal communication. How exactly does listening to a person communicate via headphones or speakers change the way a communicator's voice is heard and understood? A key difference in consuming sound using headphones or speakers is that listeners *localize* the sound (i.e., detect its origin) differently. Localizing the direction and distance of sound is a central part of the listening process. The ability to localize sound is present at birth and important for survival, as it helps people to navigate the world more safely, such as recognizing when and from where a potential threat is approaching (Abdollahi et al., 2017).

Sound localization also impacts communication and social interactions as it allows people to recognize where someone talking to them is located and respond accordingly, such as turning toward a person who is speaking to them. When hearing someone speak in a non-mediated environment, for example, the listener is typically able to effectively detect where the person's voice is coming from. This ability to position a sound in space occurs because sounds reach a listener's left and right ears at slightly different times and intensities (i.e., interaural time differences and interaural intensity differences; Middlebrooks & Green, 1991), providing listeners the ability to localize the direction from which the sound originated. As a result, an individual can determine the general location of someone they hear, even when they are unable to see the communicator.

Speakers deliver sound into a room, mimicking a natural and realistic listening experience. Speakers allow for a shared listening experience with others in the room, and create an expansive sound that listeners localize as external to themselves (Blesser & Salter, 2007). In contrast, because headphones deliver sound directly into the ear, they provide a more personalized and isolated experience (Kallinen & Rabaja, 2007) while diminishing a listener's ability to position a sound in space, causing a phenomenon known as 'in-head localization'—the sensation that the sound is originating from within the listener's own head (Blauert, 1997; Wenzel, 1992; Whitaker, 2005). In-head localization has been considered a negative aspect of headphones when listening to audio that may benefit from a surround sound experience, such as when listening to music meant for an amphitheater (Planet of Sound, 2021). For this reason, in recent years there have been increased efforts to create audio sound effects for headphones that decrease in-head localization, providing listeners with the sensation that the sound is all around them, more like listening via speakers or in a concert hall (e.g., 8D and binaural sound effects; Cohen, 2021; Webb, 2020). Such efforts have been particularly of interest in the development of virtual reality experiences, as soundscapes that increase the perception of being in a 3D space can enhance the sensation of physically "being there" (Rajguru, Obrist, & Memoli, 2020). In contrast to previous examinations of the downsides of in-head localization, the current paper instead investigates its potential *benefits*, in particular focusing on how in-head localization may enhance feelings of closeness to the communicator.

Properties of Felt Closeness

The factors that determine one's subjective perception of closeness to another person or object (or, conversely, distance from them) have been studied extensively (e.g., Aron et al., 1991; Aron et al., 1997; Charness & Gneezy, 2008; Ghorbani et al., 2013; Gino & Galinsky, 2012; Liberman & Trope, 2008). A foundational relevant theory is that of psychological distance (Liberman & Trope 2014; Trope & Liberman 2011), which posits that the perceived distance between a target (e.g., an object or individual) and the present self consists of four interchangeable dimensions: spatial distance (i.e., being farther or nearer in physical space), social distance (i.e., feeling emotionally more distant or closer), temporal distance (i.e., being more removed in time or closer in time), and probabilistic distance (i.e., being less or more likely to occur). All four dimensions are cognitively related in that they use the same level of mental construal, thereby similarly and systematically impacting preferences and choices (Maglio et al., 2015; Trope & Liberman 2010).[1]

Perceiving something as distant on one dimension can lead the observer to perceive it as distant on another dimension (Trope & Liberman 2010)—regardless of whether the perceived

[1] See Maglio (2020) for a recent review of how the four dimensions of distance are cognitively related yet not necessarily identical.

distance is subjective (e.g., it *feels* physically distant) or objective (e.g., it *is* physically distant; Maglio, 2019). The two dimensions of psychological distance that are particularly relevant to the current investigation are *spatial* distance—for example, feeling *physically* more distant from the communicator of an auditory message—and *social* distance—feeling *socially* and/or *emotionally* more distant from the communicator. Along with the aforementioned research on the interrelated nature of the four dimensions of distance, additional prior research further supports the strong association and bidirectionality between spatial and social distance specifically. [2]

In one series of experiments demonstrating the automatic nature with which perceivers associate spatial and social dimensions (Bar-Anan et al., 2007), participants performed a modification of the Stroop Task in which they viewed words made to appear spatially near or far. The meaning of the words displayed further manipulated a second dimension—social distance (e.g., “we” vs. “others”). Responses were the fastest when spatial and social distances were congruent (e.g., when “we,” a more proximal representation of social distance, was displayed spatially nearer, or when “others,” a more distal representation of social distance, was displayed spatially farther). Other studies have shown that increasing distance in one dimension can cause people to infer greater distance in the other. In one study that built on previous findings that politeness in speech connotes social distance (as people tend to use more formal language with strangers and those with whom they are less close; Brown & Levinson, 1987), the more participants believed a target was spatially distant, the more likely they were to use polite language (Stephan, Liberman, & Trope, 2010). The authors also found the reverse: reading scenarios written more formally (vs. colloquially; a proxy for social distance), increased

[2] While most research suggests that spatial and social distance are bidirectionally related (e.g., Bar-Anan et al., 2007; Stephan et al., 2010; Won, Shriram, & Tamir, 2018), see also Zhang and Wang (2009) which suggests that spatial distance influences the other three dimensions of distance but not vice versa.

perceptions of spatial distance. In a different set of experiments, manipulating social distance in a text conversation between two people likewise influenced estimates of spatial distance (Won et al., 2018). This result fits with other research findings that show people are likely to sit farther from those with whom they feel less comfortable and sit closer to those with whom they feel socially closer (Mackinnon, Jordan, & Wilson, 2011; Mooney, Cohn, & Swift, 1992). The opposite has also been demonstrated whereby spatial distance can influence feelings of social distance (Maglio, 2019). For example, in a series of experiments, male participants preferred female targets who were, or appeared to be, physically closer to them (Shin et al., 2019). Based on the interchangeable nature of these dimensions, spatial distance has been used as an implicit measure of social distance (Macrae, Bodenhausen, Milne, & Jetten, 1994).

Extending from prior research, we propose that the auditory medium through which people listen to a message—specifically, headphones or speakers—can influence both how spatially close, as well as how socially close, the listeners feel to the communicator. We make this prediction for two reasons. First, as previously noted, by using headphones, sound can be brought closer—even internal—to the self, increasing its proximity to a listener. In doing so, listening to a message via headphones provides an intimate listening experience that increases both the objective proximity of the sound (i.e., the sound heard is physically closer to the listener), as well as the subjective proximity of *the communicator* (i.e., the perception that the person speaking is physically closer). Second, the in-head localization caused by headphones creates the sensation that the communicator's voice is originating from within one's own head (e.g., that the voice is internal to the self)—creating a sense of social closeness to the communicator. Building on the previous research demonstrating that spatial and social distance are cognitively related, can causally influence one another, and lead to similar outcomes, we couple these two dimensions into a single construct we term *felt closeness*[3] and examine how perceptions of felt closeness differ as a function of auditory medium. Specifically, we predict that listening to a message in headphones will increase felt closeness to the communicator.

H1: Listening to a message via headphones will enhance felt closeness—both spatial and social closeness—to a communicator compared to listening to the same message via speakers.

H2: The effect of auditory medium (headphones vs. speakers) on felt closeness will be mediated by in-head localization (i.e., the perception that the communicator's voice is coming from within one's own head).

Consequences of Felt Closeness

To the extent that headphones lead listeners to feel closer to a communicator than do speakers, there should be systematic consequences of auditory media on judgments of, and behavior toward, communicators. We focus on communicators making emotional and persuasive appeals, as these are both common and particularly consequential for attitudinal and behavioral outcomes, and investigate three possible consequences of auditory medium, each of which derive directly from the enhanced feelings of closeness caused by headphones (vs. speakers).

The first predicted consequence is that listening to a message in headphones can lead people to form a more positive impression of the communicator, specifically perceiving them as warmer—a fundamental judgment underlying perceptions of and behaviors toward people (Cuddy, Fiske, & Glick, 2008; Fiske, Cuddy, Glick, & Xu, 2002) and organizations (Aaker, Vohs, & Mogilner, 2010).[4] Supporting this prediction, prior research has found an association

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[3] We choose to label the construct "felt closeness" because it involves only two of the four psychological distance dimensions, spatial and social distance.

[4] Social impressions can involve attributing both warmth and competence to another person. We focus on warmth (not competence) because prior research hasn't focused as much on the potential link between feeling close to

between closeness (both spatial and social) and impression formation—specifically, perceptions of friendliness and warmth. We first consider the link between social closeness and perceptions of warmth. Extensive evidence suggests people feel and behave more favorably toward others with whom they have a shared interest or identity (i.e., in-group members, a form of social closeness; Turner, Brown, Tajfel, 1979). In one study, hearing another individual self-disclose not only led receivers to feel closer to that individual but also to like him or her more (Sprecher, Treger, & Wondra, 2012). Moreover, socially close others are perceived more concretely (e.g., as having more human attributes), whereas socially distant others are perceived more abstractly, which can involve "colder" cognition-based judgements and lead to dehumanization (i.e., lacking human attributes; Haslam, 2006; Haslam & Loughnan, 2014).

Next considering the link between spatial closeness and impressions of warmth, individuals have been shown to have higher impressions of strangers who are more spatially proximal to them (e.g., seated closer to them; Patterson & Sechrest, 1970). Similar associations have been shown between spatial distance and brand evaluation: brands representing connectedness or friendship are evaluated more positively when shown spatially closer to a customer (Chu, Chang, & Li, 2021; Huang, Li, & Zhang, 2013). Specifically, Chu, Chang, & Li (2021) find that for popular brands (i.e., brands representing broader appeal), individuals form more positive attitudes, judge them as warmer, and are willing to pay more for them when they are shown more spatially proximal. Based on this previous research, we predict headphones, by increasing felt closeness to the communicator, will lead listeners to perceive the communicator as warmer.

H3a: Listening to a message via headphones will increase perceptions of a

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someone and believing them to be competent. However, for completeness we empirically measure perceptions of both warmth and competence.

communicator's warmth compared to listening to the same message via speakers, an effect mediated by felt closeness.

Our second predicted consequence is that by increasing felt closeness, listening to someone via headphones will also increase empathy toward them. Supporting this prediction, prior research indicates that, as social distance decreases, empathy increases (Liberman, Stephan, & Trope 2007). Increasing feelings of closeness can enhance one's emotional response to another (Small & Loewenstein, 2003), and can lead people to experience each other's emotions more strongly (e.g., Hatfield, Cacioppo, & Rapson, 1993; Jackson, Brunet, Meltzoff, & Decety, 2006). Having more empathy for someone can then increase helping behavior (Batson, Duncan, Ackerman, Buckley, & Birch, 1981; Decety & Jackson, 2004; Eisenberg & Miller, 1987). Indeed, increasing social closeness to a recipient can increase aid provided to the recipient, driven by heightened emotional concern for them (Loewenstein & Small, 2007). Relatedly, closeness can increase generosity: in one set of experiments, participants who felt socially closer to their partners (manipulated by reduced anonymity) behaved significantly more generously toward them in a dictator game (Charness & Gneezy, 2008). In another field experiment with over 30 thousand individuals, people were significantly more likely to donate, and donated more on average, to others who had the same surname as them—a finding which the authors attribute, in part, to increased feelings of closeness to similar others (Munz, Jung, & Alter, 2020).

Other research links spatial distance with empathy and helping behaviors. For example, reducing the physical distance between waitresses and patrons can lead to greater tipping behaviors (Jacob & Guéguen, 2010). As another example, people are more willing to donate to nearby versus faraway targets, both when the distance is real or perceived, driven by the belief that their donation will have a greater impact (Touré-Tillery & Fishbach, 2017). Relatedly, in a different set of experiments, researchers found that increasing the accessibility of a goal to impact the lives of others led people to donate more to nearby (vs. faraway) causes (Xu, Rodas, & Torelli, 2020). Considering this prior research all together leads us to expect that if headphones indeed increase felt closeness, they should also then lead listeners to feel and behave more empathically toward the communicator.

H3b: Listening to a message via headphones will increase felt empathy and behavioral empathy (e.g., helping) toward a communicator compared to listening to the same message via speakers, an effect mediated by felt closeness.

Last, we predict that listening to a message via headphones has the potential to enhance persuasion. Closeness can affect a person's persuasive abilities, as people are more likely to conform to behaviors exhibited by those to whom they feel close or with whom they identify (Goldstein & Cialdini, 2007). For this reason, people are more persuaded by messages from their in-group (vs. out-group; Mackie, 1986; Mackie, Gastardo-Conaco, & Skelly, 1992; Turner et al., 1987). Feelings of closeness can even influence behaviors toward a firm—feeling connected to a company not only improves perceptions of the company and its products, but also increases purchase intentions (Schlosser & Shavitt, 2009; Sen & Battacharya, 2001). Such influence extends to narration, as the persuasive power of stories are, in part, due to identification with characters (Green & Brock, 2000; Slater & Rouner, 2002; Van Laer, De Ruyter, Visconti, & Wetzels, 2014).

Further, spatial proximity to another, be it real or imagined, has been shown to predict social influence (Latane, 1981)—the mere presence of another can influence someone's behavior (Argo, Dahl, & Manchada, 2005), and the perceived proximity (near or far) of an individual can affect their degree of influence (Moon, 1999). For instance, in one study, people were more persuaded by a communication partner they thought was near them (in their own city) than a communication partner they thought was far away (in a distant city; Bradner & Mark, 2002). In a different experiment, observers were more likely to imitate a model who was spatially closer to them (vs. distant from them; Hansen, Alves, & Trope, 2016). We thus predict that headphones—by increasing felt closeness to the communicator—will also increase a communicator's persuasiveness.

H3c: Listening to a persuasive appeal via headphones will increase persuasion compared to listening to the same message via speakers, an effect mediated by felt closeness.

Overview of Studies

Five studies test the theory that listening to a message via headphones (vs. speakers) increases how close, both spatially and socially, a listener feels to the communicator of a message and, subsequently, affects their related judgments of and decisions about the communicator and their message. Study 1 provides an initial test of our hypothesis that listening to a communicator's message through headphones increases feelings of closeness to them more than listening to their message via speakers. Studies 2-5 test two of our predicted psychological consequences—perceptions of the communicators' warmth, and felt empathy toward communicators. Study 3 additionally tests whether listening to a persuasive message via headphones (vs. speakers) enhances persuasion. Study 4 examines our proposed underlying mechanism of in-head localization, testing whether the effect of auditory medium on felt closeness is attenuated when headphone listeners hear audio that recreates the sensation of speakers (i.e., the perception that communicators are surrounding the listener). Finally, Study 5 tests whether the auditory medium changes behavior in a consequential field setting, specifically examining the extent to which listening to a podcast via headphones or speakers affects listeners' likelihood of helping the communicator. We report our predetermined our sample sizes, all data exclusions, all manipulations, and all measures in the main text and Web Appendix.

Study 1: Felt Closeness

Study 1 is an initial test of our hypothesis that listening to a communicator's message via headphones (vs. speakers) increases felt closeness. Study 1 also provides convergent validity for different measures of felt closeness and examines the quality of the sound experience as an alternative possibility for why auditory medium could influence felt closeness.

Method

Prior to data collection we preregistered our sample size, predictions, and analysis plan for this study (https://aspredicted.org/blind.php?x=h5eq8p).[5] We aimed to collect 1,000 participants and planned to use only qualifying participants (i.e., participants were required to have both headphones and speakers available to ensure random assignment, had to confirm using the proper equipment, and pass a listening check). In total, 1,005 participants from Amazon Mechanical Turk completed the study in exchange for Amazon.com credit; of these, 797 (M_{age} = 39.04, *SD* = 12.63, 54.1% female) passed our preregistered inclusion criteria and are included in the analyses (see Web Appendix A for details).

This study was conducted near the start of the coronavirus outbreak in the United States (i.e., the COVID-19 pandemic). At the beginning of the study, participants were reminded that

[5] We intended to additionally examine how different vocal cues could interact with the effect of medium (see preregistration). To do so, we asked a professional voice actress hired on Fiverr.com to read the clip in two ways, one with more emotion and the other with less emotion in her voice. However, perhaps because a professional voice actress is trained to express emotion in her voice, the differences between the two clips proved to be subtle: there were no differences across clips on any dependent variables (*p*s > .09) or within modality (*p*s >.27). Indeed, a separate analysis of the paralinguistic cues in the two audio clips using *Praat* revealed similarities between the actor's pitch (emotional M = 208.54 Hz, SD = 38.57; emotionless M = 181.97 Hz, SD = 22.62) and volume (emotional M = 60.26 Db, SD = 22.57; emotionless M = 60.72 Db, SD = 21.68), and the length of the clip (185 sec for emotional clip and 179 sec for emotionless clip) for each reading. Thus, we collapsed the two clips in our analysis.

they must have both headphones and speakers available for use and were asked to confirm this was the case before continuing the study. Participants were then randomly assigned to listen to a clip using either their headphones or speakers and were again asked to confirm they had their assigned equipment ready and available. They were then informed that they would be listening to a clip in which a woman told her story about the impact that coronavirus had on her and her family. Participants were asked to listen carefully to the audio clip and then answer the questions that follow. The clip was adapted from a true story and can be heard (along with the clips used in all studies) at https://bit.ly/3grGqKe.

After listening to the clip, to measure *felt closeness*, participants responded to a two-item scale: "To what extent did you feel as though [the communicator] was physically near you?" (measuring perceived spatial closeness) and "To what extent did you feel a sense of distance between yourself and [the communicator]?" (measuring perceived social closeness when reverse-coded; 1 = *not at all*, 7 = *very*). We preregistered using this two-item index as our primary measure of felt closeness in this study and all subsequent studies.

To further examine the validity of our measures, we included other measures of spatial and social closeness. As a more concrete assessment of spatial closeness, we asked participants to report their objective *physical proximity* to the sound source: "please estimate (in feet, using the scale below) about how far the sound was from your ears when you were listening today (from 0 feet if you listened in headphones to 5 feet or more if you listened with speakers across the room" (0 = *0 ft,* 5 = *5 ft. or more*).[6] As an alternative assessment of social closeness, we asked participants to report their *familiarity* to the communicator using a single item previously used by Stephan, Liberman, and Trope (2011) to measure subjective perceptions of

[6] This measure also serves as a manipulation check of the equipment used (as described in preregistration).

closeness: "Please indicate how familiar [the communicator] seems (for example, you may have a sense of knowing her somewhat or not at all)" (1 = *not at all familiar*, 7 = *very familiar*).

To examine an alternative explanation for the effect of auditory media, participants rated their overall *sound experience* (1 = *not at all good*, 7 = *very good*). We expected that even when controlling for perceived sound experience (i.e., the quality/fidelity of the audio), there would still remain an effect of auditory medium on felt closeness. Finally, participants reported their demographics and responded to several exploratory items and robustness checks (see Web Appendix B).

Results

Felt closeness. As expected, the two items measuring spatial and social closeness were highly correlated, $r(795) = .60$, $p < .001$. Supporting our primary prediction, participants who heard the message via headphones reported significantly greater felt closeness ($M = 4.65$, $SD = 1.52$) than participants who listened via speakers ($M = 4.21$, $SD = 1.62$), $b = .44$, $t(795) = 3.93$, $p < .001$, $d = .28$. We also examined each item separately: participants who heard the message via headphones reported feeling spatially closer ($M = 4.62$, $SD = 1.72$) and socially closer ($M = 4.68$, $SD = 1.69$) to the communicator compared to participants who listened via speakers ($Ms = 4.03$ and 4.40, $SDs = 1.89$ and 1.73), $bs = .60$ and .28, $ts(795) = 4.65$ and 2.32, $ps < .001$ and .021, $ds = .33$ and .16.

In addition, participants reported that the sound source was physically closer to their ears in the headphones condition ($M = .89$, $SD = 1.39$) than in the speakers condition ($M = 1.95$, $SD = 1.28$), $b = -1.06$, $t(795) = -11.15$, $p < .001$, $d = .80$. Participants who heard the message via headphones also reported that the communicator seemed significantly more familiar ($M = 4.15$, $SD = 1.68$) than participants who listened via speakers ($M = 3.77$, $SD = 1.73$), $b = .38$, $t(795) =$

3.17, $p = .002$, $d = .23$. Indeed, the 2-item felt closeness scale correlated significantly with the physical proximity item, $r(795) = -.12$, $p < .001$, and the familiarity item, $r(795) = .54$, $p < .001$.

Robustness analyses. Participants reported a better sound experience in the headphones condition ($M = 6.45$, $SD = .92$) than in the speakers condition ($M = 6.24$, $SD = 1.11$), $b = .21$, $t(795) = 2.91$, $p = .004$, $d = .21$. Notably, however, the main effect of medium on felt closeness remained significant when controlling for ratings of sound experience ($p < .001$). Results maintain the same pattern when controlling for all other control variables we collected (see Web Appendix B).

Discussion

Study 1 provides initial support for our hypothesis that listening to a message via headphones (vs. speakers) increases felt closeness, including both spatial and social closeness, to the communicator. The fact that the auditory medium showed similar effects on other measures of spatial closeness (i.e., proximity to the sound equipment) and social closeness (i.e., familiarity) provides further construct validity for our measures. Supporting prior literature (e.g., Bar-Anan et al. 2007; Maglio et al., 2015; Trope & Liberman 2010), the spatial and social closeness measures correlated closely with one another, as well as with alternative measures of spatial and social distance, suggesting that they examine a convergent psychological construct: felt closeness. Thus, our future studies rely on the overall construct of felt closeness using the two-item scale, although we also report results separately on each item to be thorough.

Study 1 further demonstrated that the effect of auditory medium on felt closeness was robust to the wide variety of personal equipment used in participants' daily lives (see Web Appendix B for an analysis of the equipment participants used), suggesting high ecological validity of our findings. We also found that, although headphones (vs. speakers) do improve the perceived sound experience, the increase in felt closeness experienced via headphones occurs above and beyond this difference.

Study 2: Impression and Empathy

Study 2 tests whether the effect of auditory medium on felt closeness observed in Study 1 generalizes to other auditory stimuli. Study 2 also explores two of our predicted consequences. Specifically, it tests whether an increase in felt closeness (via headphones) leads listeners to perceive the communicators as warmer and express greater empathy toward them.

Method

Prior to data collection we preregistered our sample size, predictions, and analysis plan for this study (https://bit.ly/3pt23xV).[7] Based on the effect size in Study 1 and a pilot study (see power analysis in preregistration), we aimed to collect 1,300 participants and again planned to use only qualifying participants (i.e., participants had to upload a photo of both their headphones and their speakers prior to taking the study, and pass a listening check). In total, 1,310 adults from Amazon Mechanical Turk completed the study in exchange for Amazon.com credit; of these, 1,132 (M_{age} = 31.90, SD = 9.39, 49.4% female) passed our inclusion criteria and are included in the analyses (see Web Appendix C for details).

We assigned participants to listen to a clip we anticipated would induce empathy—a mother and daughter talking about being homeless[8]—via headphones or speakers. To measure

[7] Some conceptual modifications were made to the preregistration to describe results more clearly in the manuscript. In the manuscript, we changed the name of the variable "presence" to be "felt closeness" because it describes the scale items more clearly. We also renamed the "empathic accuracy" item to be "empathic inference" and the "perceived authenticity" item to be "genuineness" because we thought those labels were closer to the actual measures. We do not report mediation analyses for the generosity measure as it did not differ between conditions. Finally, while we preregistered that participants would be asked to upload a photo of their equipment, we did not pre-specify this as an exclusion criterion. However, we decided to exclude participants who did not follow instructions in order to reduce selection bias and because we could not ensure exposure to the manipulation.

[8] Adapted from NPR's StoryCorps https://storycorps.org/stories/kris-kalberer-and-erika-kalberer/. To listen to this clip and the others in this paper: https://bit.ly/3grGqKe.

our primary dependent variable of *felt closeness*, participants responded to the same two-item felt closeness scale from Study 1, $r(1130) = .47, p < .001$. We additionally examined another construct that we expected to show similar results as felt closeness, participants' *immersion* in the audio clip, by asking participants to respond to two items: "I was immersed in the audio while listening to it," and "While listening to the audio, I was distracted by activity going on in the room around me" (reverse-coded) (1 = *not at all*, 7 = *very*), $r(1130) = .47, p < .001$.

Next examining our hypothesized consequences, to measure *warmth* of the communicators, participants completed adapted measures of the 5-item warmth scale from Fiske, Cuddy, Glick, and Xu (2002; $\alpha = .83$). For completeness, participants also responded to their 5-item competence scale ($\alpha = .76$). Specifically, they reported the extent to which they perceived the communicator to be caring, sincere, tolerant, likable, and good-natured (warmth), as well as confident, intelligent, competent, independent, and competitive (competence).

We measured a common component of empathy (Ickes, Stinson, Bissonette, & Garcia, 1990)—*empathic inference*, how well one thinks they understand the feelings of another: "To what extent were you able to tell how [the communicators] were feeling?" We further examined how *genuine* the communicators would be perceived: "How genuine did [the communicators] sound?" (1 = *not at all*, 7 = *very*).

Finally, to measure *willingness to donate* to the communicators, we informed participants they had been entered into a lottery for $25 and asked them to indicate, should they win, what portion of the $25 they would choose to donate on behalf of Kris and Erika on a sliding scale from $0 to $25 in increments of $1. Following the study, we randomly selected one participant to receive the portion of $25 they selected; the remainder was donated to charity.

To test for robustness, participants rated their overall *sound experience* using the same item as Study 1, and also indicated how much other activity and noise was going on in the room around them (*environmental distraction*; 1 = *none*, 7 = *a lot*). We expected that even when controlling for perceived sound experience and environmental distraction, there would still remain an effect of auditory medium on felt closeness. Participants also reported their demographics and responded to several exploratory items and additional robustness checks (see Web Appendix D).

Results

Felt closeness. Supporting our primary hypothesis about closeness, participants who heard the message via headphones reported significantly greater felt closeness (M = 4.75, SD = 1.41) than participants who listened via speakers (M = 4.29, SD = 1.42), b = .46, t(1130) = 5.53, p < .001, d = .33. Specifically, participants who heard the message via headphones reported significantly greater spatial closeness (M = 4.63, SD = 1.74) and social closeness (M = 4.88, SD = 1.54) to the communicator compared to participants who listened via speakers (*Ms* = 4.09 and 4.48, *SDs* = 1.73 and 1.60), *bs* = .53 and .40, *ts*(1130) = 5.16 and 4.25, *ps* < .001, *ds* = .31 and .25. Further, participants who heard the message via headphones also reported greater immersion (M = 6.29, SD = .88) than those who listened via speakers (M = 5.88, SD = 1.21), b = .41, t(1130) = 6.59, p < .001, d = .39.

Psychological consequences. Supporting our hypothesis about perceived warmth, participants believed communicators were significantly warmer when they heard them via headphones (M = 5.99, SD = .84) than via speakers (M = 5.86, SD = .86), b = .13, t(1130) = 2.59, p = .010, d = .15. On the other hand, there was no difference in perceived competence across conditions ($M_{headphones}$ = 4.48, $SD_{headphones}$ = 1.08 versus $M_{speakers}$ = 4.41, $SD_{speakers}$ = 1.10), b = .07, t(1130) = 1.10, p = .27, d = .07). However, consistent with previous findings that warmth and competence are often positively correlated when making judgements of others (Fiske, Cuddy, & Glick, 2007; Judd et al. 2005), both scales moved in the same direction and were significantly correlated with each other, $r(1130) = .55$, $p < .001$.

Supporting our hypothesis about empathy, participants in the headphones condition reported stronger empathic inference (i.e., a greater ability to tell how the communicators were feeling; $M = 6.11$, $SD = 1.03$) compared to participants in the speakers condition ($M = 5.97$, $SD = 1.06$), $b = .14$, $t(1130) = 2.28$, $p = .023$, $d = .14$. They also reported perceiving the communicators as marginally more genuine ($M = 6.30$, $SD = .98$) compared to participants in the speakers condition ($M = 6.19$, $SD = 1.06$), $b = .12$, $t(1130) = 1.93$, $p = .054$, $d = .11$.

Donation. Although empathic inference positively correlated with donation amount, $r(1130) = .14$, $p < .001$, there was no difference between conditions on whether someone donated (82.8% of headphones and 83.8% of speakers participants donated; $p = .652$), the amount donated overall ($M_{headphones}$ = \$13.03; $M_{speakers}$ = \$13.19; $p = .772$), or among those who donated ($M_{headphones}$ = \$15.73; $M_{speakers}$ = \$15.74; $p = .992$). This suggests that the medium of listening did not change empathy enough to affect donations, at least in this context.

Mediation. To test whether increased perceptions of warmth and increased empathic inference after listening via headphones (vs. speakers) was driven by felt closeness, we conducted two mediation analyses with 1,000 bootstrapped samples (Hayes, 2013). The mediation models indicated that felt closeness mediated the effect of medium on both perceived warmth of communicators (95% CI [.06, .13]) and empathy toward them (95% CI [.07, .16]; see Figure 2).

[insert Figure 2 about here]

Robustness analyses. Participants reported a better sound experience in the headphones condition ($M = 6.47$, $SD = .92$) than in the speakers condition ($M = 6.04$, $SD = 1.23$), $b = .43$, $t(1130) = 6.67$, $p < .001$, $d = .40$. Participants who listened via headphones also reported less activity and noise going on in the room around them ($M = 1.79$, $SD = 1.25$) than participants who listened via speakers ($M = 2.03$, $SD = 1.35$), $b = -.24$, $t(1130) = -3.08$, $p = .002$, $d =.18$.[9] Felt closeness remains significantly greater among participants who listened via headphones (vs. speakers) when controlling for participants' ratings of sound experience and reported environmental distraction ($p = .001$). Results maintain the same pattern when controlling for all other control variables we collected (see Web Appendix D).

Discussion

Study 2 provides further support for our hypothesis that listening to a message via headphones (vs. speakers) leads to increased felt closeness using a different audio clip. As with Study 1, the findings of this study were robust to the wide variety of personal equipment used in participants' daily lives, as well as to differences in perceived sound experience and environmental distractions. Moreover, Study 2 demonstrates that felt closeness consequently led to greater perceived warmth of communicators and greater empathic inference toward them. Contrary to our predictions, felt closeness did not increase number or size of donations to the communicators. Notably, a high percentage of participants in both conditions donated (over 82%), suggesting a possible ceiling effect. We return to examine helping behavior again in a

[9] This item was originally included to test whether the effect of headphones on felt closeness was robust to the variety of locations and environmental distractions in which participants completed the study. Although this was meant to be an objective measure of environmental distraction, and very well may reflect that participants who listened in headphones were indeed in quieter spaces, we note that this result could also reflect the immersive experience of headphones, reducing *awareness* of external noise/distractions (an interpretation that would be consistent with our findings on the subjective measure of immersion). In other words, it may have been that participants were in a less noisy environment than speakers, or that they were simply less aware of the noise around them.

different form and context in Study 5.

Study 3: Persuasion

Study 3 tests our third predicted consequence of felt closeness: persuasion. Because our theory suggests that headphones increase feelings of closeness and connection with the communicator, we predicted that the persuasiveness of a message would be greater when listening via headphones (vs. speakers), an effect mediated by felt closeness.

Method

We aimed to collect 800 participants and, as in the previous studies, planned to use only qualifying participants. In total, 805 adults from Amazon Mechanical Turk completed the study in exchange for amazon.com credit; of these, 697 (M_{age} = 37.59, *SD* = 12.06, 53.4% female) passed our inclusion criteria and are included in the analyses (see Web Appendix E for criteria and details).

To examine persuasion in this study, we selected a message that included a persuasive appeal. In the message, a communicator describes driving home from her college graduation when a driver on their cellphone ran a red light and caused a tragic accident, killing both of her parents and leaving her fighting for her life.[10] The message concludes with an attempt to persuade listeners that "distracted driving kills; safe driving starts with you." Prior to the manipulation, we measured participants' baseline opinions about the dangers of cell phone use while driving: "In your opinion, how risky is it IN REALITY to use a cell phone while driving?" (0 = *not at all risky*, 10 = *extremely risky*). The pre-manipulation attitude on the dangers of driving and cell phone use was not different across experimental conditions (*p* = .694). Next, we

[10] This clip was adapted from a Public Service Announcement created by the U.S. Department of Transportation (https://www.youtube.com/watch?v=IwAUkh_7pKA). To Listen to the clip used in this study: https://bit.ly/3grGqKe.

assigned participants to listen to the message via headphones or speakers.

Participants responded to the same scale from Study 1 measuring *felt closeness*, $r(695) = .59$, $p < .001$, and the same items from Study 2 measuring *empathic inference* and perceived *genuineness*. We also measured *liking* of the communicator using a single item: "How much did you like [the communicator]?" (1 = *not at all*, 7 = *very much*).

To measure *persuasion*, we used three items designed to measure attitude change (a central tenet of both message-based persuasion and social influence; Wood, 2000): "How many deaths from cell phone related crashes do you think occur in the US each week?" (1 = *much less than 50*, 5 = *much more than 50*; the mid-point of the scale was close to the accurate number, 56, of weekly deaths in the US from distracted driving at the time of the study; Centers for Disease Control, 2016), "How dangerous do you think it is for people to use their phones while driving?" (1 = *not at all*, 7 = *extremely*), and "How likely are you to remind friends and family not to use their phones while driving?" (1 = *not at all*, 7 = *extremely*).

Finally, participants responded to the same items as in Study 2 measuring their *sound experience* and *environmental distraction* (external noise/activity), as well as the *volume* at which they listened to the clip (0 = *extremely quiet*, 100 = *extremely loud*). Participants also reported their demographics and responded to several exploratory measures and robustness checks (see Web Appendix F-G).

Results

Felt closeness. Consistent with prior studies, participants who listened via headphones reported greater felt closeness ($M = 4.85$, $SD = 1.53$) than participants who listened via speakers ($M = 4.52$, $SD = 1.63$), $b = .33$, $t(695) = 2.78$, $p = .006$, $d = .21$. Specifically, participants who heard the message via headphones reported significantly greater spatial ($M = 4.69$, $SD = 1.86$)

and social closeness (M = 5.01, SD = 1.60) to the communicator compared to participants who listened via speakers (Ms = 4.29 and 4.75, SDs = 1.91 and 1.72), bs = .40 and .27, $ts(695)$ = 2.81 and 2.11, ps = .005 and .035, ds = .21 and .16.

Psychological consequences. Consistent with Study 2, participants in the headphones condition reported stronger empathic inference (M = 6.45, SD = .89) than did participants in the speakers condition (M = 6.30, SD = .96), b = .15, $t(695)$ = 2.13, p = .034, d = .16. They also reported perceiving the communicators as marginally more genuine (M = 6.69, SD = .73) compared to participants in the speakers condition (M = 6.58, SD = .86), b = .11, $t(695)$ = 1.87, p = .062, d = .14. However, participants reported liking the communicator no differently between conditions (p = .637).

Supporting our hypothesis that headphones increase persuasion, participants who listened via headphones believed that significantly more people die each week as a result of cell phone related crashes (M = 4.09, SD = 1.01) compared to participants who listened via speakers (M = 3.93, SD = 1.08), b = .16, $t(695)$ = 2.07, p = .039, d = .16. Further, a greater proportion of participants who heard the message via headphones reported the most extreme option “many more deaths” occur each week (45.9%) than participants who heard the message via speakers (37.1%), χ^2 (1, N = 697) = 5.51, p = .019, ϕ = .09). After listening to the clip via headphones (vs. speakers), participants thought that driving while using a cell phone was marginally more dangerous ($M_{headphones}$ = 6.48, SD = .90 vs. $M_{speakers}$ = 6.34, SD = 1.07), b = .14, $t(695)$ = 1.84, p = .067, d = .14.

We further examined whether results were robust when controlling for participants’ baseline opinion of the dangers of distracted driving. When controlling for baseline opinion, participants still reported significantly greater felt closeness and empathic inference, and perceived the communicator as marginally more genuine (*ps* = .006, .037, and .068, respectively), when they listened via headphones (vs. speakers). The effect of medium on liking remained nonsignificant. Participants also reported believing that significantly more people die each week from cell phone related crashes ($p = .042$), and that driving while using a cell phone was significantly more dangerous ($p = .030$) when they listened via headphones vs. speakers. There was no effect of medium on the likelihood of reminding others not to use their phones while driving, $b < .01$, $t(695) = .02$, $p = .987$.

Mediation. To examine whether the persuasive effects in the headphones condition were driven by felt closeness, we conducted mediation analyses with 1,000 bootstrapped samples (Hayes, 2013). As hypothesized, felt closeness mediated the perceived prevalence of deaths (95% CI [.01, .07]), and perceived danger (95% CI [.02, .13]; see Figure 3).

[insert Figure 3 about here]

Robustness analyses. Participants reported a marginally better sound experience when listening to the message via headphones ($M = 6.32$, $SD = 1.05$) than via speakers ($M = 6.17$, $SD = 1.12$), $b = .15$, $t(695) = 1.86$, $p = .063$, $d = .14$. Participants did not report any differences in volume between conditions nor how much reported activity was going on in the room around them when listening to the audio (*p*s > .30). Felt closeness remained significantly greater among participants who listened via headphones (vs. speakers) when controlling for sound experience, environmental distraction, and volume ($p = .009$). Results maintain the same pattern when controlling for all other control variables we collected (see Web Appendix G).

Discussion

Study 3 conceptually replicated the findings from prior studies using a new clip, demonstrating that listening to a message via headphones again caused participants to experience greater felt closeness to the communicator of the message, and to feel more empathy for her. However, despite finding that headphone listeners thought the communicator was marginally more genuine than speaker listeners, listeners did not report liking the communicator more, a somewhat surprising null result given that in Study 2 headphones listeners perceived the communicators as significantly warmer. This may suggest that likability and impression of a communicator's warmth are not interchangeable constructs, or simply that our one-item liking variable was not reliable. Participants in both conditions reported average liking scores of over 6 (on a 7-point scale), suggesting a potential ceiling effect.

We found preliminary support for our hypothesis that by increasing felt closeness, listening to a persuasive message in headphones (vs. speakers) led participants to be more persuaded by the message they heard. Specifically, participants who listened to a persuasive personal testimonial about distracted driving via headphones reported a greater shift in their attitudes and beliefs about the dangers of distracted driving. These results suggest that simply *how* people listen to a persuasive message can influence its degree of persuasiveness. These findings have potential implications for both organizational and consumer behavior, as many marketing and behavior change campaigns—ranging from public service announcements, to marketing advertisements, to managerial messages—are designed to influence consumer and employee perceptions, attitudes, and behaviors.

Study 4: In-Head Localization

Study 4 tests our proposed mechanism that in-head localization (i.e., the sensation that the communicator's voice originates within one's own head) drives the effect of auditory medium on felt closeness. If the effects of listening to a communicator via headphones (vs. speakers) are indeed driven by in-head localization, then listening to audio via headphones that makes communicators' voices sound as if they are coming from outside the listener's head (i.e., in the room around them) should attenuate the influence of medium on felt closeness. To help further validate our measure of felt closeness, we also included a different measure that has been used to assess interpersonal closeness: self/other overlap (Aron, Aron, & Smollan, 1992).

Method

Prior to data collection we preregistered our sample size, predictions, and analysis plan for this study (https://aspredicted.org/blind.php?x=rt6bp8). We aimed to collect 900 participants and again planned to use only qualifying participants. In total, 898 adults from Amazon Mechanical Turk participated in exchange for Amazon.com credit; of these 819 (M_{age} = 38.87, *SD* = 12.33, 46.9% female) passed our preregistered inclusion criteria and are included in the analyses (see Web Appendix H for details).

This study employed a 3-cell between-participants experimental design. In one condition, participants listened to the same clip from Study 2 via headphones in its traditional format (also called a 2D recording, for which in-head localization occurs when listening via headphones). In a second condition, participants listened via headphones to a modified format of the clip called an 8D recording, which is an audio effect designed to reduce in-head localization when listening via headphones. 8D audio technology applies effects like spatial reverb to a traditional (2D) audio clip to create the sensation that the sound is moving around a listener (vs. within their head). The effect only works when heard via headphones and is meant to recreate the feeling that one is listening to the audio via speakers (The Groove Cartel, 2020). We further included a third comparison condition in which participants listened to the (2D) recording via speakers. Thus, participants were randomly assigned to one of the following three conditions: listening via headphones to the original 2D clip, listening via speakers to the original 2D clip, or listening via headphones to the modified 8D clip.

To measure *felt closeness* participants responded to the same two-item felt closeness scale from Study 1, $r(817) = .66$, $p < .001$. To provide convergent validity for the felt closeness scale, participants then responded to the *Inclusion of Other in the Self (IOS) scale*, a validated single-item visual scale designed to measure self/other overlap, which has been shown to capture interpersonal closeness (Aron, Aron, & Smollan, 1992). In answering the scale, participants saw seven pairs of circles that ranged from almost touching to almost completely overlapping. One circle in each pair was labeled "self" and the other was labeled "Kris" (the name of the mother from the audio clip). Participants were asked which of the pairs of circles best represents how they felt toward the communicator (Kris) when listening to the clip. Participants then responded to the same two items measuring *empathic inference* and perceived *genuineness* from Study 2.

Participants next responded to an item designed to measure our manipulation of in-head localization: "When listening to the clip, it may have sounded like [the communicators'] voices were inside your head, or it may have sounded like their voices were coming from somewhere else in the room around you. Using the scale below, indicate which was more true of your experience listening" (1 = *their voices sounded like they were in my head*, 7 = *their voices sounded like they were in the room around me*; for ease of interpretation, this measure was reverse-coded). Finally, participants responded to the item measuring *sound experience* from Study 1, reported their demographics, and responded to an attention and robustness check (see Web Appendix I).

Results

Felt closeness. As predicted, and consistent with our theory, participants who listened to the 2D clip via headphones ($M = 4.77$, $SD = 1.52$) reported significantly greater felt closeness than both participants who listened to the 2D clip via speakers (*M* = 4.45, *SD* = 1.51), *b* = .32, *t*(816) = 2.38, *p* = .018, *d* = .21, replicating results from prior studies, and participants who listened to the 8D clip via headphones (*M* = 4.21, *SD* = 1.64), *b* = .56, *t*(816) = 4.28, *p* < .001, *d* = .35, providing support for our hypothesized mechanism of in-head localization. There was also a marginal (unpredicted) difference in felt closeness between participants who listened to the 2D clip in speakers and those who listened to the 8D clip in headphones, *b* = .23, *t*(816) = 1.70, *p* = .089, *d* = .15.[11]

We further examined the measure of self/other overlap, which we expected to show convergent results as our felt closeness measure. As predicted, participants who listened to the 2D clip via headphones (*M* = 3.77, *SD* = 1.77) reported significantly greater overlap between themselves and the communicator than both participants who listened to the 2D clip via speakers (*M* = 3.34, *SD* = 1.67), *b* = .43, *t*(816) = 2.85, *p* = .004, *d* = .25), and participants who listened to the 8D clip via headphones (*M* = 3.47, *SD* = 1.73), *b* = .30, *t*(816) = 2.10, *p* = .036, *d* = .17). There was no difference in reported overlap between participants who listened to the 2D clip in speakers and those who listened to the 8D clip in headphones, *b* = -.13, *t*(816) = -.86, *p* = .393, *d* = -.08.

Psychological consequences. Unlike the prior two studies, participants who listened to the 2D clip via headphones did not report any differences in felt empathic inference compared to

[11] We also examined the two items comprising the closeness scale separately. First, participants who listened to the 2D clip via headphones (*M* = 4.77, *SD* = 1.73) reported significantly greater spatial closeness than both participants who listened to the 2D clip via speakers (*M* = 4.39, *SD* = 1.75), *b* = .38, *t*(816) = 2.45, *p* = .015, *d* = .22), and participants who listened to the 8D clip via headphones (*M* = 4.25, *SD* = 1.80), *b* = .52, *t*(816) = 3.53, *p* < .001, *d* = .29). Participants who listened to the 2D clip via headphones (*M* = 4.78, *SD* = 1.63) also reported greater social closeness than participants who listened to the 2D clip via speakers (*M* = 4.50, *SD* = 1.63), *b* = .27, *t*(816) = 1.87, *p* = .063, *d* = .17), and participants who listened to the 8D clip via headphones (*M* = 4.18, *SD* = 1.74), *b* = .59, *t*(816) = 4.27, *p* < .001, *d* = .35). Perceived spatial closeness did not differ between participants who listened to the 2D clip in speakers and those who listened to the 8D clip in headphones (*p* = .358); however, participants who listened to the 2D clip in speakers felt socially closer to the communicator than participants who listened to the 8D clip in headphones (*b* = .32, *t*(816) = 2.22, *p* = .027*, d* = .19).

participants who listened to the 2D clip via speakers (p = .785). Empathic inference also did not differ between participants who listened to the 2D audio in headphones and those who listened to the 8D audio in headphones (p = .490), nor between those who listened to the 2D audio in speakers and those who listened to the 8D audio in headphones (p = .350).

Similarly, participants who listened to the 2D clip via headphones perceived no difference in genuineness compared to participants who listened to the 2D clip via speakers (p = .684). On the other hand, participants who listened to the 8D clip via headphones (M = 6.11, SD = 1.23) perceived the communicator as less genuine than both participants who listened to the 2D clip via headphones (M = 6.31, SD = 1.10), b = -.19, t(816) = -2.10, p = .036, d = -.17, and speakers (M = 6.35, SD = .97), b = -.23, t(816) = -2.42, p = .016, d = -.21.

In-head localization. In support of our manipulation, participants who listened to the 2D clip via headphones (M = 4.02, SD = 1.88) reported that the communicators' voices sounded more like they were in their own head compared to participants who listened to the 2D clip via speakers (M = 2.60, SD = 1.45), and participants who listened to the 8D clip via headphones (M = 3.38, SD = 1.95), bs = 1.42 and .64, t(816) = 9.07 and 4.27, ps < .001, ds = .83 and .33, respectively. Participants who listened to the 8D clip via headphones also reported that the voices sounded like they were more in their head than those who listened to the 2D clip via speakers, b = .78, t(816) = 5.02, p < .001, d = .45.

Mediation. We conducted two mediation analyses with 1,000 bootstrap samples (Hayes, 2013). Our first mediation analysis tested whether in-head localization mediated the effect of medium (headphones vs. speakers) on felt closeness among participants who listened to the 2D audio. Medium (1 = headphones, 0 = speakers) served as the predictor variable, in-head localization as the mediating variable, and felt closeness as the dependent variable. This analysis confirmed in-head localization mediated the effect of medium (headphones vs. speakers) on felt closeness (95% CI [.02, .25]). Our second mediation tested whether in-head localization mediated the effect of the clip heard through headphones (2D clip vs. 8D clip) on felt closeness. Audio clip (2D = 1, 8D = 0) served as the predictor variable, in-head localization as the mediating variable, and felt closeness as the dependent variable. This analysis confirmed in-head localization mediated the effect of clip (8D vs. 2D) on felt closeness (95% CI [.004, .12]; see Figure 4).

[insert Figure 4 about here]

Robustness analyses. Participants reported no difference in sound experience when listening to the 2D clip via headphones ($M = 6.22$, $SD = 1.01$) or speakers ($M = 6.11$, $SD = 1.01$), $b = .11$, $t(816) = 1.03$, $p = .303$, $d = .11$. Participants who listened to the 8D clip reported the sound experience as significantly worse ($M = 5.46$, $SD = 1.50$) compared to both participants who listened to the 2D clip in headphones and participants who listened in speakers, *b*s = -.76 and -.65, *t*s(816) = -7.59 and -6.23, *p*s < .001, *d*s = -.60 and -.50. When controlling for sound experience, the difference in felt closeness remains significantly higher among participants who listened to the 2D clip in headphones compared to those who listened via speakers ($p = .032$), and non-significantly higher than those who listened to the 8D clip in headphones ($p = .111$). Finally, when controlling for sound experience there was no significant difference in felt closeness between participants who listened to the 8D clip in headphones and those who listened to the 2D clip in speakers ($p = .573$).

Discussion

Study 4 supports in-head localization as one key mechanism explaining why auditory medium increases felt closeness. When participants listened to the 2D clip of communicators speaking (i.e., the original clip used in the previous experiments for which in-head localization occurs when heard via headphones), they reported that it sounded more like the communicators' voices were in their head when heard through headphones (vs. speakers), thereby enhancing felt closeness. When participants listened to an 8D version of the clip via headphones (i.e., an applied audio effect designed to mimic a surround-sound experience thereby reducing in-head localization and recreating the effect of listening via speakers), the effect of medium on felt closeness was attenuated. In addition, Study 4 provides convergent validity for our felt closeness scale by demonstrating that headphones (vs. speakers) also increase feelings of self/other overlap (another measure of interpersonal closeness). Our findings suggest that there were differences in sound experience across conditions. It is possible that 8D audio technology is currently better suited for music than speech or is still novel enough that it is somewhat distracting; as technologies advance, future research could continue to examine the effect of listening to 8D clips via headphones on felt closeness and other outcomes.

Study 5: Auditory Medium Affects Behavior

Study 5 tests our predictions in a consequential experiment-in-the-field. Community members listened to a clip from a new podcast (via headphones or speakers), and were asked to provide their thoughts about the podcast and given an opportunity to act on behalf of the communicator. Specifically, individuals had the opportunity to perform two consequential helping behaviors after listening to an excerpt from the podcast: (1) write a letter in support of the communicator they heard receiving an award; (2) sign up to learn more about how to help spread the word about the communicator's company. A third behavioral measure provided individuals with the opportunity to subscribe to the podcast. We hypothesized that auditory medium would influence listeners' behaviors, which would have both organizational and marketing implications. Specifically, this experiment tests whether, in a field setting, listening to a message in headphones increases felt closeness and the likelihood of carrying out effortful helping behaviors.

Method

Prior to data collection we preregistered our sample size, predictions, and analysis plan for this study (https://aspredicted.org/blind.php?x=fc3kf4). In contrast to Studies 1-4, during which participants used their own headphones and speakers in their location of choice (resulting in a wide variety of equipment used and locations employed, creating statistical noise), in Study 5, we controlled which auditory equipment participants used as well as the environment in which they listened to the message. As a result of this more tightly controlled design, we anticipated needing a smaller sample size than in previous studies. We preregistered that we would collect data between February 6th and February 21st, based on availability of research assistants, with the goal of collecting at least 200 participants during that time.[12] In total, 228 community members participated. We excluded two individuals who did not follow instructions in the headphones condition (one person used their own headphones and one person did not place the headphones on their ears), bringing the final sample to 226.

We set up a booth on a university campus representing the business school's journal: The [school name] Business Journal and covered it with a school-logo tablecloth and materials for the business journal, including tents, take-away one-pagers, and business cards. Passersby were informed that the journal was promoting and looking for feedback on their brand-new podcast.

[12] Based on availability of research assistants (and weather), data was collected on February 6th, 11th, 14th, 18th, 19th, and 20th. Data collected on February 12th followed a different protocol due to internet connectivity issues; these changes involved participants taking the survey on two separate platforms, which increased interruptions by the RA and significantly changed the flow of the survey. Thus, any surveys collected on the date of February 12th were not included in the data analysis.

Notably, while we designed the experiment to test our theory, all materials from the journal and podcast used were real and not related to the current research. Moreover, because we conducted this experiment under the guise of collecting feedback for the journal, individuals who participated were unaware that they were part of an experiment (or that there were multiple conditions). Specifically, research assistants posing as representatives of the journal asked passersby if they would listen to a short excerpt from the journal's new podcast and provide feedback. Individuals who agreed were informed that they would listen to a clip from the podcast in which a school alumna spoke about the mission of her company. The audio clip was a 2-minute clip from the podcast's very first episode which featured a school alumna who is now the CEO of a local company that provides visual information for the blind and low vision. Participants were given an iPad to listen to the podcast, either via headphones (participants in this condition were handed a pair of headphones along with the iPad) or via speakers. Whether people listened to the clip via headphones or speakers varied by hour to prevent participants from seeing others taking the survey using a different medium. We asked participants to step to the side to minimize any shared listening experiences (as prior research indicates that shared experiences are amplified and we wanted to eliminate this confound; Boothby, Clarke, & Bargh, 2014).

After listening to the clip, participants provided feedback by responding to several questions. Using the same scale as in the previous studies, participants reported *felt closeness*, $r(224) = .22$, $p < .001$. Participants also responded to the two items measuring *empathic inference* and perceived *genuineness* from Study 2. (Although the content of the clip in this study was not as emotional as in previous studies, we included these items for completeness.) In addition, in this study we also measured empathy in a second way: participant's perceived *ability* *to detect the emotion in a communicator's voice*. We anticipated that headphones would enhance listener's perception that they could detect the emotion in the communicator's voice that express their thoughts and feelings. Specifically, we asked participants: "To what extent could you detect the emotion in [the communicator's] voice?" (1 = *not at all*, 7 = *very*).

We measured *helping behavior* using two real effort tasks. First, to measure willingness to help the communicator directly, participants read: "[The communicator] is being nominated for the [school name] Alumni Award for her work helping the blind! Would you like to write a few sentences to support [the communicator] getting this award?" (Yes/No).[13] Participants who indicated wanting to help then had the opportunity to write their support for her nomination. Second, to measure willingness to help the company they heard about, participants read: "[The company] is looking for people to help spread the word about their life-changing technology. Would you like to learn more about what you can do?" (Yes/No). Participants who indicated "yes" then had the opportunity to provide their email address. A third behavioral item measured general interest in the podcast to which they listened: "Would you like to receive an email or text message with a direct link to subscribe to the [business journal name] Podcast?" (Yes/No). Participants who said yes then had the opportunity to provide their email or phone number.

Finally, we included control variables at the end of the survey. To ensure that participants in both conditions could hear the audio equally well, we asked: "How well could you hear the audio?" (1 = *not at all well*, 7 = *very well*). Lastly, participants indicated whether they had previously heard of the podcast: "Had you heard of the [business journal name] podcast prior to today?" (Yes/No).

After completing the survey, individuals returned the iPad and had the option to take

[13] This item was added after data collection began and preregistered separately (https://osf.io/qj7xe). As a result, the sample size is slightly smaller for this item.

candy from a bowl on the table, if they chose. The research assistant recorded where the participant listened (five options: away from the table alone, away from the table with other people, next to the table alone, next to the table with other people, or didn't see), how much noise/activity there was in the area at the time (three options: lots of people/activity, medium amount of people/activity, small amount of people/activity), and wrote any noteworthy comments about the participant. Research assistants recorded the location and noise level for all but one participant.

Results

Felt closeness. Supporting our prediction and consistent with the previous studies, participants who listened to the podcast in headphones reported greater felt closeness ($M = 4.27$, $SD = 1.30$) than participants who listened via speakers ($M = 3.94$, $SD = 1.16$), $b = .34$, $t(224) = 2.03$, $p = .043$, $d = .27$. Unlike in the previous studies, spatial closeness did not significantly differ between participants who heard the message via headphones ($M = 3.86$, $SD = 1.67$) compared to participants who listened via speakers ($M = 3.66$, $SD = 1.71$), $b = .20$, $t(224) = .87$, $p = .384$, $d = .12$. On the other hand, consistent with the previous studies, participants who listened via headphones felt socially closer ($M = 4.69$, $SD = 1.58$) to the communicator versus participants who listened via speakers ($M = 4.21$, $SD = 1.40$), $b = .48$, $t(224) = 2.39$, $p = .018$, $d = .32$.

Psychological consequences. Participants in the headphones condition did not report a significant difference in felt empathic inference toward the communicator ($M = 4.73$, $SD = 1.43$) than participants in the speakers condition ($M = 4.60$, $SD = 1.41$), $b = .13$, $t(224) = .68$, $p = .496$, $d = .09$. However, they did perceive the communicator as marginally more genuine ($M = 5.55$, $SD = 1.37$) than participants in the speakers condition ($M = 5.21$, $SD = 1.35$), $b = .34$, $t(224) =$

1.85, $p = .066$, $d = .25$. Further, participants who listened via headphones reported a greater ability to detect the emotion in the communicator's voice ($M = 4.91$, $SD = 1.45$) than participants in the speakers condition ($M = 4.47$, $SD = 1.40$), $b = .44$, $t(224) = 2.31$, $p = .022$, $d = .31$.

Behavior. Consistent with our hypothesis, passersby who listened to the podcast via headphones were significantly more likely to agree to help the communicator by writing a nomination for her to receive an award compared to those who listened via speakers (30.2% in headphones vs. 13.9% in speakers), $b = .99$, $z(157) = 2.39$, $p = .017$. Further, individuals who listened in headphones were also more likely to want more information on how to help the company compared to participants who listened via speakers (28.6% in headphones vs. 17.0% in speakers), $b = .67$, $z(225) = 2.02$, $p = .043$. A non-significantly greater proportion of those who listened via headphones signed up to receive a subscription link to the podcast compared to participants who listened via speakers (18.3% in headphones vs. 11.0% in speakers), $b = .59$, $z(225) = 1.50$, $p = .133$.

Mediation. To examine whether felt closeness mediated the effect of medium on helping behavior, we conducted two mediation analyses with 1,000 bootstrap samples (Hayes, 2013). Felt closeness did not mediate willingness to help the communicator (95% CI [-.02, .05]), or willingness to help the company (95% CI [-.01, .03]). Felt closeness did significantly correlate with likelihood of helping the communicator, $b = .59$, $t(157) = 3.51$, $p < .001$, but did not correlate with likelihood of helping the company more generally, $b = .17$, $t(225) = 1.37$, $p = .171$.

Robustness analyses. Across the full sample, 8.4% of participants reported having heard of the podcast. Participants reported no difference in ability to hear the audio when listening in headphones ($M = 6.29$, $SD = 1.09$) than speakers ($M = 6.11$, $SD = 1.11$), $b = .17$, $t(223) = 1.18$, $p = .238$, $d = .16$. Research assistants indicated that there was little environmental distraction (i.e., noise and activity) for 84.4% of the surveys, medium distraction for 12.0% of the surveys, and a lot of distraction for only 3.6% of the surveys. Additionally, research assistants indicated that 41.3% of participants listened away from the table while alone, 56.9% listened near the table while alone, and the remaining four participants listened with others (.01% listened away from the table with others, and .01% listened near the table with others). Felt closeness remained marginally greater among participants who listened via headphones (vs. speakers) when controlling for how well they could hear the clip, whether they had heard of the podcast, where they listened to the clip, and external noise/activity (p = .089).

Discussion

As an experiment-in-the-field, Study 5 demonstrates that listening via headphones (vs. speakers) can increase felt closeness. Passersby were asked to provide feedback on a new podcast and were unaware that they were part of an experiment. This study also provides evidence of an important behavioral measure: willingness to help. Individuals who listened in headphones (vs. speakers) were over twice as likely to volunteer to spend time writing a nomination to support the communicator winning an award and were more likely to want additional information about how to help spread the word about the company the communicator worked for. Surprisingly, felt closeness did not mediate willingness to help in this experiment—however, it is unclear whether helping was driven by something other than felt closeness or we were simply underpowered to detect mediation. The effect of auditory medium on empathic inference was weak in this study (and inconsistent in other studies) though, as mentioned in the method section, this auditory clip was less emotionally evocative than those used in previous studies. We consider the broader effect of headphones on empathic inference, as well as other measures, more thoroughly in the General Discussion.

General Discussion

Americans spend an average of four hours per day listening to audio (Inside Radio, 2019). As such, organizations, managers, and policymakers are dedicating an increasing amount of their advertising, telecommunication, and training spend to auditory channels. While both managers and employees likely put a great deal of thought into *what* is listened to, our findings suggest that they should also consider *how* it is heard. The present research provides a first examination of the impact of different auditory technologies on felt closeness and its consequences. We examine how listening to messages via the two most ubiquitous auditory media—headphones and speakers—affects listeners' psychological experiences and subsequent behaviors.

Five studies demonstrate that listening to a message via headphones (vs. speakers) increases listeners' felt closeness—including both spatial and social closeness—to the communicators (Studies 1-5). As a result of increased felt closeness, listeners who heard a message via headphones perceived the communicators as warmer (Study 2), felt somewhat greater empathy toward them (Studies 2 and 3, although not Studies 4 and 5), were more persuaded by them (Study 3), and were potentially more likely to help them (Study 5, although not Study 2). On the whole, the results suggest that the greater felt closeness derived from listening to a message via headphones (vs. speakers) can influence people's subsequent attitudes and behaviors. We further demonstrate that the increase in felt closeness from listening via headphones (vs. speakers) is at least in part driven by in-head localization—the sensation that the communicator's voice is originating in the listener's head—and that the effect of the auditory medium on felt closeness attenuates when headphone listeners hear an audio clip designed to reduce the in-head localization of sound (Study 4). The effects that we observed were largely consistent both online and in the field, with different populations, across different types of headphones and speakers, and using different messages and communicators.

Theoretical Contribution

Our findings advance theory in several ways. First, we advance research on the psychology of technology by examining how the use of different auditory technologies influences perceptions, judgments, and behaviors. Recent research has studied how advents in social technologies affect individual psychology, like how the use of social media influences wellbeing (Orben & Pryzbylski, 2019; see review in Lieberman & Schroeder, 2020) and how certain online algorithms influence decision-making (Dietvorst, Simmons, & Massey, 2015, 2018; Logg, Minson, & Moore, 2019; Raveendhran & Fast, 2021; Yeomans, Shah, Mullainathan, & Kleinberg, 2019). By studying the medium through which people hear information, and connect with others, we investigate a key feature encompassing all auditory technologies. Specifically, rather than simply focusing on how technologies impact the listener more broadly, we focus on how the medium used to listen changes perceptions of the communicator whose message is being broadcast.

Second, we contribute to the literature on auditory stimuli. Past work has largely examined how the content or the communicator of a message can impact its effectiveness (e.g., Freling et al. 2020; Morales, Scott, & Yorkson, 2012; Tormala & Petty, 2004; Wiener & Chartrand, 2014). We add to this literature by demonstrating that it is not just the *content* or *communicator* that may influence listeners' response to a message, but also *how* a message is heard. Specifically, we find that listening to a message via headphones provides a more intimate listening experience in which a communicator's voice is localized within the listener's own head. As a result, listening to a message in headphones (vs. speakers) increases feelings of closeness to the communicator—and consequently impacts listeners' judgments of and behavior towards the communicator.

Third, we contribute to the literature on feelings of closeness and psychological distance (Aron et al., 1991; Gino & Galinsky, 2012; Liberman & Trope, 2008). Specifically, we investigate a new method in which feelings of closeness to another can be manipulated: in-head localization. By using technology that localizes a communicator's voice inside a listener's head, people feel a greater sense of closeness—both spatial and social closeness—to the communicator, providing researchers with a novel means to increase subjective perceptions of closeness. We also provide additional support for the association between social and spatial distance in a new context.

Fourth, with a focus on technologies used in daily life, we build on prior research on both narrative transportation (Green & Brock, 2000; Van Laer et al., 2014) and presence (Biocca et al., 2003; Cummings & Bailenson, 2015). This prior work investigates the perceptions of being transported into a separate space—for instance, the extent to which a person felt like they were *physically in* a video game while playing it, or like they were transported *into* a narrative world while reading a novel. In contrast, rather than investigating perceptions of being transported into another space with a mediated other, we introduce and investigate perceptions of bringing the mediated other internal to the self. Further, previous research in this domain focuses primarily on interactions with virtual partners, machine-generated voices, and mediated communication (Biocca et al., 2003; Heeter, 1992; Lee & Nass, 2005; Sanchez & Slater, 2005; Short et al., 1976; Slater & Wilbur, 1997; Van Laer et al., 2014). In contrast, we examine beliefs about human communicators (not avatars or characters) delivering unidirectional messages, reflecting the current delivery of auditory messages such as advertisements, political appeals, and public service announcements. We also contribute to the literature on narrative transportation and narrative persuasion (Green & Brock, 2000; Moyer-Gusé, 2008; Van Laer et al., 2014) by demonstrating a new way in which people can feel a connection to the communicator of a message and be more persuaded by them.

Organizational Implications

A great deal of thought is often spent on the content of auditory messages, but less attention is given to the *way* in which a person listens to the message. Our findings suggest that organizations, managers, and marketers should consider where to place certain ads based on the media through which they will likely be heard. For instance, if aiming to have listeners feel close to the communicator or be particularly persuaded by their message, managers should consider placing their ad or message on a program often consumed via headphones (such as a podcast). On the other hand, if a message does not require listeners to experience any feelings of closeness to the communicator, then where the message is placed (e.g., podcast vs. talk radio) would be less essential.

Technological advances are also changing the face of organizational communication, making auditory media an integral part of the workday. For instance, in 2018, $87.6 billion was spent on industry trainings, with 69% involving virtual classroom/webcasting/or video broadcasting (Training, 2018). Trainings and other workplace communications often involve an auditory component in which employees listen to a communicator deliver a message or a training. As such, organizations may consider this research when designing their trainings or webinars. For example, managers might encourage employees to listen to safety trainings or webinars using headphones, which may more effectively change their attitudes and behaviors compared to listening via speakers. Relatedly, telework is also becoming more commonplace—

in 2017, as much as 25% of US employees reported working remotely at least some of the time (Virtual Vocations, 2017). In 2020, the world was forced to make telework the norm, and many predict that working remotely (and thus using digital communication throughout the workday) will be much more commonplace in the future (Madsen, 2021). Thus, managers may wish to encourage headphone-use for work-related virtual communication.

This research could also be used by organizations to tailor consumer experiences. Movie theaters and museums, for example, may wish to strategically use headphones to enhance felt closeness, which may increase consumer experience and demand (although effects of the medium may also be different in public contexts when listening with others is a shared experience). Further, this research could be of interest to music and ad-supported radio streaming services, such as Spotify or Pandora, which have around 124 million and 63 million active listeners per month, respectively (Bossi, 2020).

Limitations and Directions for Future Research

Each of our contributions also elicits new questions for future research. One question relates to the content and communicator of the message. The messages in our studies involved relatively noncontroversial topics delivered by generally likable communicators, but how might headphones influence psychological consequences when the communicators or topics are more divisive? Perhaps when listening to an emotionally painful or polarizing message (e.g., an ad from an opposing political party), contexts in which an individual may wish to have greater social distance from the communicator, listening in headphones may lead to discomfort or even reactance. Future studies could examine whether auditory technologies affect felt closeness, and its consequences, when listeners hear messages on controversial topics, or messages delivered by communicators they dislike. In such contexts, listening via speakers may be preferred and could lead to more positive (or at least, less negative) evaluations as well as attitude and behavior changes.

A second question is about the mechanism underlying the effects of auditory medium that we observed. Theoretically and empirically, our research indicates that in-head localization is critical to our effects, but it is less clear how additional aspects of the media (e.g., sound quality, volume) also contribute. In the marketplace, high-quality headphones cost a fraction of the price of a high-quality or professional speaker system (which are relatively inaccessible to the general public). As a result, the average pair of headphones may be better quality than the average pair of speakers. Although we found that the effect of auditory medium on felt closeness occurs above and beyond different perceptions of sound experience, future research could investigate how quality differences contribute to perceptions of the communicator.

A third research question concerns whether there are variables that we did not test in the current studies that could moderate the effect of auditory medium on closeness. One potential moderator is listeners' preexisting familiarity with the communicator. Our theory suggests headphones increase feelings of closeness/familiarity—thus, there may be less of an effect of headphones (vs. speakers) if a listener is already highly familiar or close to the communicator. A second moderator could be the presence of others while listening: Does simply being in the presence of others (vs. alone), thus making listening a shared experience, change the effect of media on felt closeness to the communicator (as well as to other listeners)? A third moderator worth considering is the addition of communicators; given that past research finds that the proximity and size of a group moderates the effects of the presence of others on consumer experiences (Argo et al., 2005), and the present studies only involved one or two communicators, future research could assess whether the observed effects hold when listening to more communicators. A final moderator that we investigated ourselves in a supplemental study (see Web Appendix J) is the nature of the communicator's voice. We posit that headphones increase feelings of closeness because listeners experience the communicator's voice—and, by extension his or her expressed thoughts and feelings—intimately inside their own heads (in-head localization). This suggests that if a communicator's voice is devoid of thoughtfulness and emotionality (like a robot voice), then listeners may feel no differently toward the communicator whether they hear them in their own heads (i.e., via headphones) or outside of their heads (i.e., via speakers). We find initial evidence for this possibility (see Web Appendix J).

Last, a fourth question concerns inconsistencies of the effect of auditory medium on some of the dependent variables that we observed across our studies—in particular, on ratings of empathic inference and perceived genuineness. To test whether empathy differed significantly by medium across studies, we pooled the empathic inference item measuring perceived ability to detect the communicator's emotions across all studies where it was asked: Study 2, Study 3, Study 4 (participants who heard the 2D clip in headphones and speakers only), and Study 5. A regression with a dummy variable for each study indicates that across all four studies, there was a significant effect of medium on empathic inference, $b = .11$, $t(2,578) = 2.51$, $p = .012$, $d = .08$. To test whether perceived genuineness of the communicator differed by medium across studies, we conducted the same analysis and found a significant effect of medium on perceived genuineness, $b = .10$, $t(2,578) = 2.60$, $p = .009$, $d = .10$. Finally, we also tested the pooled effect of medium on felt closeness (as well as spatial and social closeness independently) across all five studies (only including participants who heard the 2D clip in headphones and speakers in Study 4). There was a significant effect of medium on overall felt closeness, $b = .40$, $t(3,374) = 7.80$, $p < .001$, $d = .27$, as well as on spatial closeness, $b = .47$, $t(3,374) = 7.72$, $p < .001$, $d = .26$, and social closeness, $b = .33$, $t(3,374) = 5.86$, $p < .001$, $d = .20$. These additional analyses are consistent with positive effects of auditory medium, but we urge readers to treat results with caution as internal meta-analyses can inflate the true effect size (Vosgerau et al. 2018) and each individual study showed only weak/inconsistent effects of medium on empathic inference and perceived genuineness.

Conclusion

As digital technology continues to grow and infiltrate our daily lives, so too will auditory media. Across our studies, we find consistent evidence that listening to a message via headphones (vs. speakers) leads listeners to feel closer to communicators, leading to different psychological and behavioral responses to messages. Despite the modest effect sizes in these studies, our samples are orders of magnitude smaller than the number of people listening to auditory messages every day; thus, auditory medium may have a wider impact than the results demonstrated in the current paper's studies. Given the ever-increasing rate of auditory messages—and virtual communication more broadly—it is important to understand how the medium through which people listen can affect their perceptions, attitudes, and behaviors.

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FIGURES

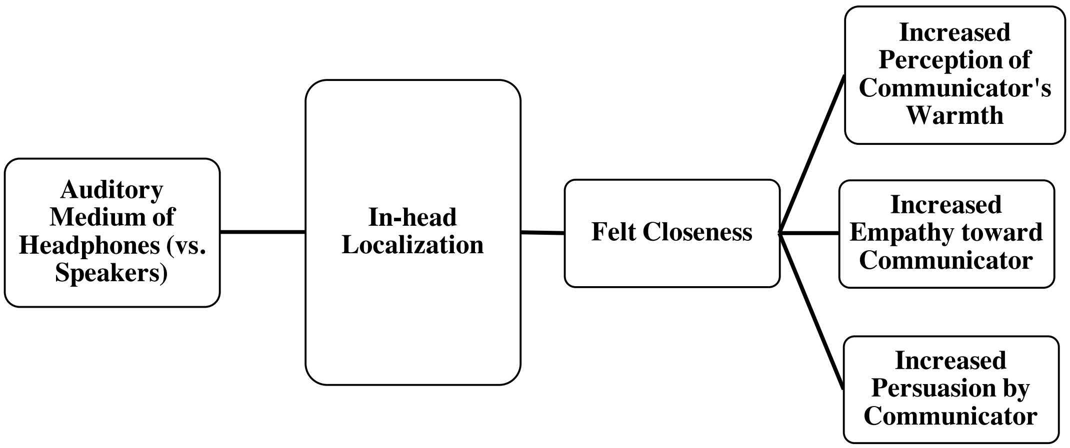

Figure 1. Headphones (vs. speakers) cause listeners to localize the sound inside their head, increasing felt closeness and leading to three key consequences.

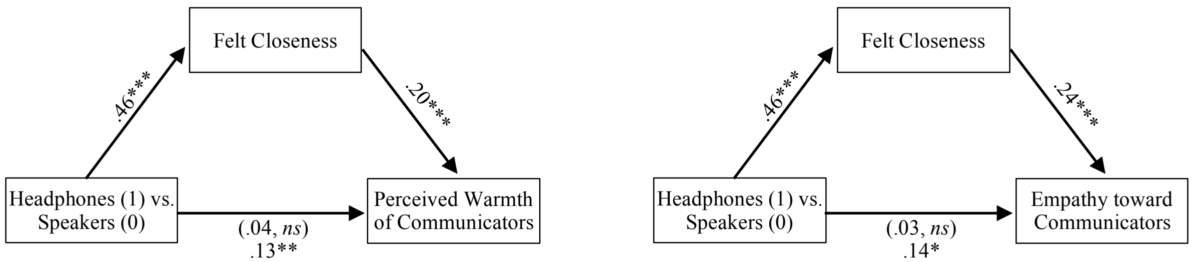

*Figure 2***.** Felt closeness mediated the effect of experimental condition on perceived warmth of communicators and empathy toward them, Study 2. The path coefficients are unstandardized betas. Values in parentheses indicate the effect of medium on the dependent variable after controlling for the mediator. **p*≤.05, ***p*≤.01, ****p* ≤.001

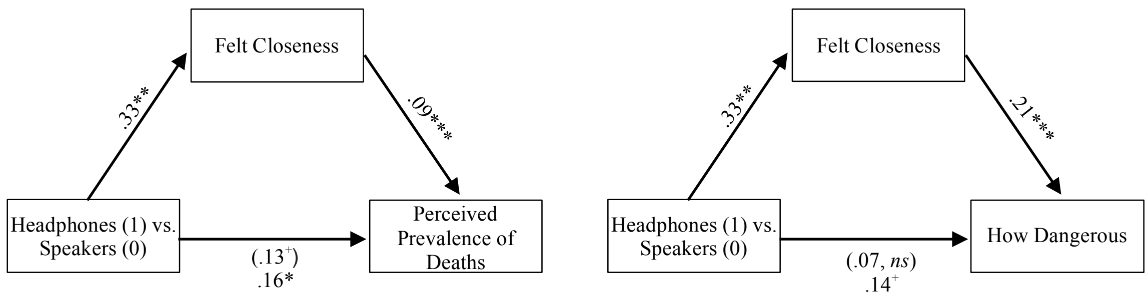

*Figure 3***.** Felt closeness mediated the effect of experimental condition on attitudes and beliefs, Study 3. The path coefficients are unstandardized betas. Values in parentheses indicate the effect of medium on the dependent variable after controlling for the mediator. $^{+}p \leq .10$, $*p \leq .05$, $**p \leq .01$, $***p \leq .001$

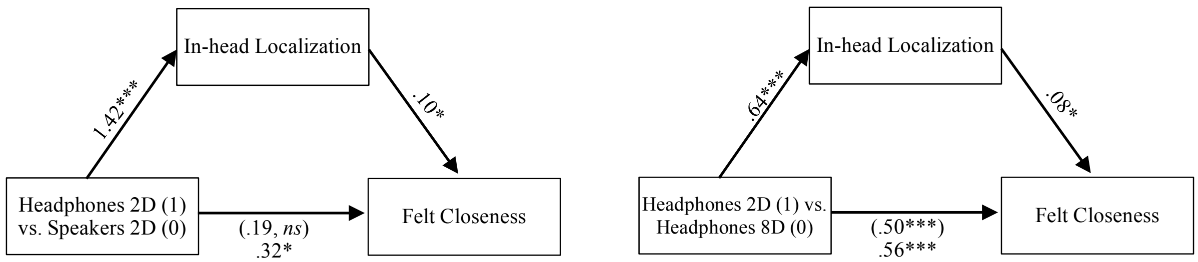

*Figure 4***.** In-head localization mediated the effect of experimental condition on felt closeness among participants who listened to the 2D audio (headphones vs. speakers), as well as among those who listened via headphones (2D audio vs. 8D audio), Study 4. The path coefficients are unstandardized betas. Values in parentheses indicate the effect of medium on the dependent variable after controlling for the mediator. *$p \leq .05$, **$p \leq .01$, ***$p \leq .001$