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**Gunseor, Michaela M.** ***Educators' Inaccurate Use of Causal Language to Describe Non-Causal Data***

## Abstract

Previous research has documented that causal language is used inaccurately in a variety of areas including the general public, students, media articles, press releases, and scientific journal articles. The following study investigated the rate at which educators used inaccurate causal language to describe non-causal research descriptions. In order to accurately use causal language in their work, researchers need to conduct experiments that (1) manipulate the causal variable while measuring the other variable (Morling, 2018) and (2) meet the three causality criteria: covariance, temporal precedence, and internal validity (Morling, 2018). In this study, 223 educators read two non-causal research descriptions about parenting topics and then generated and selected headlines that would accurately describe the research that they read. Educators generated and selected more inaccurate causal headlines and less accurate non-causal headlines than expected. Moreover, the rate at which educators generated and selected inaccurate causal language was higher than the average of other reported rates in the literature. With these findings in mind, future research should investigate the rate of inaccurate causal language use in individuals who get specific training in correlation and causation as well as other teaching methodologies that may improve individuals' language accuracy.

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## Chapter I: Literature Review

*Correlation does not imply causation* is a tenet that is constantly recited by psychology teachers, textbooks, and students alike. Although the concept of this statement is clear (correlation ≠ causation), previous research has documented that causal language is used inaccurately by the general public (Bleske-Rechek et al., 2015), high school and college students (Norris & Phillips, 1994; Norris et al., 2003), media articles (Cooper et al., 2011; Haneef et al., 2015; Schwitzer, 2008), press releases (Sumner et al., 2014; Sumner et al., 2016), and scientific journal articles from a variety of disciplines (Bleske-Rechek et al., 2018; Lazarus et al., 2015; Robinson et al., 2007). However, no previous research has examined whether educators fall prey to this bias just as other people do. For this reason, the current study will investigate the rate at which educators use inaccurate causal language to describe non-causal research descriptions.

Before investigating the rate at which educators use inaccurate causal language, it is important to understand (1) the difference between correlation and causation and (2) when causal language can be used. First, correlation means that two measured variables are related to each other. For example, if a researcher passively observed that when the temperature went up, ice cream sales also went up, they could claim that temperature is associated with ice cream sales. However, in this correlational example, there is no assumption that temperature is causing the ice cream sales to go up. On the other hand, causation means that one manipulated variable is influencing a measured variable (Morling, 2018). For example, if a researcher had some participants buy ice cream in a hot room and others buy ice cream in a normal room and they observed that ice cream sales were increased in the hot room, they could claim that temperature influences ice cream sales. Although this distinction between correlation and causation may

seem slight to some, it is important to understand when interpreting if specific claims are accurate or inaccurate based on the type of study that was conducted.

Beyond understanding these distinctions between correlation and causation, in order to claim causation, researchers also need to meet three criteria: covariance, temporal precedence, and internal validity (Morling, 2018). First, researchers need to show that there is some sort of relationship between the two variables that they are investigating (i.e., the variables covary). If there is no relationship between the two variables, then there is no potential to claim causation. Second, on a timeline, the causal variable needs to come before the other variable (i.e., the causal variable needs to have temporal precedence over the other). For example, if making a causal claim that "loud bars cause people to drink more," the researcher would need to show that the bar was loud first and drinking consumption increased later. However, documenting that one variable came before the other is tricky because, in fact, it is possible that the variables occurred in either order. That is, the louder the bar is, the more people drink OR the more people drink, the louder the bar is. Third, researchers need to eliminate alternative explanations for the relationship (i.e., ensure the relationship has internal validity). For example, in the "loud bars cause people to drink more" example it is assumed that the bar volume makes people increase their drinking consumption. However, an alternative explanation could be that as the time customers spend in the bar increases, both bar volume and drinking consumption increase. That is, bar volume and drinking consumption are not directly related. In fact, they are both influenced by a third variable – time spent at the bar. If a researcher does not meet all three of these criteria (covariance, temporal precedence, and internal validity), they should not make causal claims.

In summary, in order to claim causation, a researcher needs to conduct a well-designed experiment – the gold standard of psychological research (Morling, 2018). In a well-designed

experiment, a researcher will (1) manipulate (i.e., control and assign participants to different levels of a variable) the causal variable and measure (i.e., observe and record) the other variable. By manipulating the causal variable, researchers can also meet the criteria for causation above by ensuring that (1) the causal variable comes before the other variable (e.g., the loud bar comes before drinking consumption) and (2) other alternative explanations are eliminated (e.g., all studies are conducted at the same time of night). Once all of these requirements are met, researchers can finally claim causation. However, many research studies that do not meet these requirements also inaccurately claim causation (Bleske-Rechek et al., 2018; Lazarus et al., 2015; Robinson et al., 2007).

Next, let us look at a clearly causal statement – *sincere smiling promotes longevity*. At first glance, this statement may not make many individuals think twice; the conclusion seems clear – smiling will make you live longer. However, this statement is actually the title of a media article ("Sincere Smiling Promotes Longevity," 2010) about a study in which researchers used vintage pictures of major league baseball players to categorize their smiles into three categories – non-smilers, sincere smilers, or non-sincere smilers – which were used to predict the longevity of these individuals (Abel & Kruger, 2010). This media title misrepresents the study's findings because the researchers only used the players' pictures at one time point to predict longevity – they never *manipulated* which players smiled more or less. Because of this, it is likely that another variable, such as optimism or resilience, may be more important in predicting both the types of smiles that the players had as well as their longevity. Therefore, claiming that *sincere smiling promotes longevity* is misleading and fails to accurately communicate the findings from the study.

The previous headline is just one example of causal misinterpretation. However, inaccurate causal language occurs in a variety of areas (Bleske-Rechek et al., 2015; Bleske-Rechek et al., 2018; Cooper et al., 2011; Haneef et al., 2015; Lazarus et al., 2015; Norris & Phillips, 1994; Norris et al., 2003; Robinson et al., 2007; Schwitzer, 2008; Sumner et al., 2014; Sumner et al., 2016). In addition, causal thinking has been called a persistent bias of human cognition (Kahneman, 2011; Stanovich, 2009). Therefore, in order to understand just how persistent this bias is, it needs to be investigated in various subject groups. The research described here will add to the body of knowledge on the misinterpretation of causation from correlation by documenting if educators (a novel subject group for this area of research) also fall prey to this bias.

**Development of Causal Thinking**

One reason why causal misinterpretation may be so pervasive is because the tendency to think causally develops very early. The most popular way to assess causal thinking in young children is through a caused motion event (Muentener & Bonawitz, 2017; White, 2017). During a basic caused motion event, one object (e.g., a black circle) approaches and hits another object (e.g., a white circle). Then, something happens to the object that was hit. The seminal researcher who introduced caused motion events, Albert Michotte, conducted over 100 studies on this methodology. During these studies, Michotte (1963) documented that after seeing two objects collide, most of the time, adult individuals reported that one object *caused* the other object to move (even though the objects are inanimate and cannot *cause* anything to happen). However, Michotte also documented that adult individuals are less likely to report that one object caused the other object to move if (1) there is a delay between when the first object contacts the second object and when the second object starts to move, (2) the first object never contacts the second

object, but the second object starts to move anyway, or (3) the first object contacts the second object and then the second object starts to move away in a manner that is not consistent with the direction that it was hit.

Using the caused motion event research methodology, researchers have documented that infants as young as 6-months old perceive causality. In fact, Cohen & Amsel (1998) used caused motion events to test causal reasoning in 4-month-, 5 ½-month-, and 6 ¼-month-old infants. In this study, infants were repeatedly shown one of three caused motion events (one causal, two non-causal) until they we used to it (i.e., they were habituated). After habituation, infants were shown each of the three events. The researchers documented that, regardless of habituation condition, 4-month- and 5 ½-month-old infants looked at the causal event for longer than they did the two other non-causal events. On the other hand, the researchers documented that 6 ¼-month-old infants who were habituated to the causal event looked longer at the *non*-causal events and infants who were habituated to the non-causal events looked longer at the *causal* event. These findings suggest that at about 6 months of age infants can identify changes in causality. Because causal thinking develops early (Cohen & Amsel, 1998) and is a persistent bias of human cognition (Kahneman, 2011; Stanovich, 2009), it is important to understand how individuals interpret causal words as well as when causal misinterpretation occurs.

**Types of Causal Expressions**

Because causal misinterpretation is so pervasive, Adams and colleagues (2017) investigated how individuals interpret different causal and correlational language. Through a set of four experiments, participants were either asked to rate the causality of a sentence on a 0 (*definitely does not cause*) to 100 (*definitely does cause*) scale or asked to rank statements from the most causal to the least causal. Adams and colleagues (2017) documented that individuals

interpret causal and correlational language at four different levels: *directly causal*, *can causal*, *moderately causal*, and *conditionally correlational*.

*Directly causal* statements were interpreted as the most causal by participants. In these statements, one variable causes the second variable to do something (think back to the caused motion event where one object hit the other object). Often, these statements will contain only one causal word such as "influence" or "promote." The article title "*Sincere smiling promotes longevity"* is an example of this type of statement. The next most causal statement, a *can causal* statement, contains causal expressions preceded by the word can. For example, using our article title again, *"Sincere smiling can promote longevity*." Next, Adams and colleagues (2017) documented that individuals do not differentiate among three different forms of causal expressions: *conditionally causal*, *ambiguous*, and *correlational*. Conditionally causal expressions are preceded by modal verbs such as might, may, or could (e.g., "*Sincere smiling may promote longevity"*). Ambiguous expressions do not have a clear causal or correlational meaning such as linked to (e.g., *"Sincere smiling is linked to longevity"*). Finally, correlational expressions contain only correlational language such as associated with or related to (e.g., *"Sincere smiling is associated with longevity"*). Because individuals did not differentiate among these three types of expressions, Adams and colleagues combined them to form the *moderately causal* category. Finally, the least causal statement is a *conditionally correlational* statement. These statements contain correlational expressions along with preceding modal verbs (e.g., *"Sincere smiling may be associated with longevity"*).

As can be seen by the examples above, there are a variety of different types of causal and correlational language that can be used to describe research. However, individuals do not interpret all of this language equally (Adams et al., 2017) and causal language is only warranted

by certain study designs (Morling, 2018). For this reason, it is important to understand where and when causal language is being used inaccurately.

## The Pervasiveness of Causal Misinterpretation

After understanding when causal thinking develops (Cohen & Amsel, 1998) and how individuals interpret different types of causal expressions (Adams et al., 2017), it is important to understand exactly how pervasive the misinterpretation of causation from correlation is. To examine this, researchers have studied the pervasiveness of causal misinterpretation in a variety of different groups including individuals in the general public, students, media articles, press releases, and journal articles.

**Causal misinterpretation in the general public.** Bleske-Rechek and colleagues (2015) examined how individuals in the general public misinterpreted causation from correlation. After having participants read either a causal or correlational vignette about a research study, the participants were asked to identify which conclusions could be made about the study. The conclusions participants could select from ranged from correlational (i.e., people who spend more time doing Variable A tend to do less of Variable B) to causal (i.e., Variable A causes Variable B). Bleske-Rechek and colleagues documented that participants who were exposed to correlational vignettes selected causal conclusions at a rate that was not systematically different from participants exposed to causal vignettes. That is, individuals in the general public misinterpreted causation from correlation. Moreover, Bleske-Rechek and colleagues noted that more educated individuals performed just as poorly as less educated individuals did.

**Causal misinterpretation in students.** Documenting causal misinterpretation in the general public is not surprising based on the poor scientific literacy in the United States (Miller, 2016). In fact, Miller (2016) documented that, over the last decade, the percent of U.S. adults

that can read about, comprehend, and form an opinion about scientific information (i.e., they are scientifically literate; Miller, 1983) has remained stable at 28%. However, Miller (2016) also documented that U.S. adults with high levels of education and more exposure to college level science courses had higher rates of scientific literacy than did adults without these experiences. Although such a trend does not imply that science coursework causes higher scientific literacy, we might expect individuals who have received specific training in the sciences to have less causal misinterpretation. In fact, other researchers have investigated the likelihood that high school (Norris & Phillips, 1994) and university (Norris et al., 2003) students – individuals who do receive specific training in scientific literacy – misinterpret causation from correlation. Using a similar method for both samples, the researchers asked students to read the same set of science reports taken from science briefs, magazines, or newspapers. After reading through these reports, the researchers gave students five statements based on the report and asked them to identify the content of each statement. In both studies, along with a few other options, students were asked to identify whether each statement explained one thing generally caused or influenced another (a causal statement) or what was observed. Additionally, university students (Norris et al., 2003) were also asked to identify if each statement explained one thing was generally related to another (a correlational statement). Looking at these options, the researchers found that individuals who were given a causal or correlational statement had difficulty identifying it as such. In fact, in both studies, less than half of the students selected the correct answer when presented with these statements. However, in both studies, participants performed above chance at identifying statements that were observations. In fact, when presented with an observational statement, over 80% of participants selected the correct answer in both studies. These findings suggest that both high school and university students struggle with identifying the difference between causation

and correlation. Moreover, similar to Bleske-Rechek and colleagues (2015), Norris and colleagues (2003) documented that, for university students, the number of science courses taken was not associated with correctly identifying a statement.

It is interesting to note that Bleske-Rechek and colleagues (2015) and Norris and colleagues (2003) documented that level of education and number of sciences courses taken, respectively, were *not* associated with using more accurate causal language. These findings conflict with the findings of Miller's (2016) report that U.S. adults with high levels of education and more exposure to college level science courses had higher rates of scientific literacy than those without these experiences. Although some researchers have included an understanding of causal relationships in their definitions of scientific literacy (Davis, 1935), these opposite findings highlight that misinterpretation of causation from correlation may be different from general scientific literacy. In fact, the misinterpretation of causation from correlation may be so pervasive because it is a human bias that develops early (Cohen & Amsel, 1998) and is difficult to overcome (Kahneman, 2011; Stanovich, 2009).

**Causal misinterpretation in media articles.** Looking beyond the individuals who may misinterpret causation from correlation, many researchers have voiced concern about inaccurate causal language in media reports (Barrowman, 2014; Morling, 2018; Resnick, 2016). In line with this concern, following a trend set forth in Canada and Australia, Schwitzer (2008) looked at 500 health news stories published in popular U.S. newspapers and evening newscasts. Schwitzer rated these health news stories as "satisfactory," "unsatisfactory," or "not applicable" on ten criteria including the study methodology and quality of the evidence. Overall, Schwitzer documented that 65% of media articles were unsatisfactory in their discussion of the study's

methodology or the claims that could be made based on the evidence. That is, by inadequately reporting this information, these media articles have misrepresented the study findings.

Similarly, Cooper and colleagues (2011) investigated media articles published about individuals' diets in 10 top selling U.K. magazines. Using two evidence evaluating scales – one from the World Cancer Research Fund and the other from the Scottish Intercollegiate Guidelines Network – Cooper and colleagues documented that, out of the claims that they were able to classify, less than 20% of the claims were made based on convincing evidence. In fact, over 60% of the articles made claims based on insufficient evidence, with the remainder of articles making claims based on possible or probable evidence.

Haneef and colleagues (2015) investigated the presence of misrepresentation in international media. Using the health news section of *Google News*, after collecting news stories three days a week for six months, the researchers had a pool of 130 health news stories that discussed health interventions. In order to identify what types of misrepresentation were present in these health new stories, the researchers used three main categories of misrepresentation identified by Yavchitz and colleagues (2016) – inadequate extrapolation, misleading reporting, and misleading interpretation. Haneef and colleagues (2015) documented that 45% of the news stories had at least one form of misrepresentation in the headline and 88% had at least one form in the text of the story. Across headlines and text, the researchers documented that 41% had inadequate extrapolation, 59% had misleading reporting, and 69% had misleading interpretation. Of the 69% of news stories that had misleading interpretation, almost 50% contained the misinterpretation of causation from correlation (the largest subcategory of misrepresentation documented in the entire study). Compiling the findings from Schwitzer (2008), Cooper and colleagues (2011), and Haneef and colleagues (2015), it is clear that researchers' concern about

the misinterpretation of causation from correlation in the media is more than anecdotal. In fact, it is supported by the evidence.

**Causal misinterpretation in press releases.** Although misrepresentation has been documented in many media articles, the previous studies did not explore where this misrepresentation came from. It is possible that either the media authors created this misrepresentation, or the misrepresentation was present in the press release/journal article from which they drew the content. In order to investigate this, Sumner and colleagues (2014) looked at 462 press releases created by the top 20 U.K. research universities along with their associated scientific articles. Because all of these press releases were based on correlational research and, therefore, should not include any causal claims, each press release was investigated to assess the level of deterministic causal claims that were included. Claims were coded as either no statement, explicit statement of no relation, correlational, ambiguous, conditional causal, can cause, or unconditionally causal. Through this process, Sumner and colleagues documented that 33% of university press releases contained more deterministic causal language than did the associated journal article. In a follow-up study, Sumner and colleagues (2016) attempted to investigate misrepresentation in press releases published by science and medical journals (rather than universities). Specifically, Sumner and colleagues collected 534 press releases (along with their associated scientific articles) by gathering any press release related to human health psychology or neuroscience from 8 peer-reviewed journals. Focusing only on the correlational press releases (N = 164), once again, Sumner and colleagues found that 21% of journal press releases contained more deterministic causal language than did the associated journal article.

Although both media journalists (Cooper et al., 2011; Haneef et al., 2015; Schwitzer, 2008) and science press release writers (Sumner et al., 2014; Sumner et al., 2016) misinterpret

causation from correlation, they may not be the correct ones to blame for this misinterpretation. In their 2012 study, Yavchitz and colleagues looked at 70 press releases that covered randomized controlled trials along with their associated scientific articles and media articles. When looking through the press releases, scientific articles, and media articles, Yavchitz and colleagues identified if these documents contained misrepresentation in addition to documenting a variety of characteristics about the document (including date of publication, avenue of publication, impact factor, author status, funding source, and sample size). Out of all the variables that they collected, the best predictor of misrepresentation in press releases and media articles was misrepresentation in the original scientific article (the source document).

Not only is the best predictor of misrepresentation in a press release or media blurb misrepresentation in the source document, but also, fixing the misrepresentation in the source document improves the misrepresentation in subsequent summaries of the source document. In their 2019 study, Adams and colleagues attempted to change the inaccurate causal language in media articles by changing the content of press releases. Specifically, before a press release was published, the researchers reviewed it and randomly suggested either changes to the wording to (1) align the headline and prominent claims of the release, (2) add a caveat about what conclusions can be drawn from the study, (3) both, or (4) neither. Then, after the press release was published with the changes recommended by the researchers, the researchers looked at any media articles that were published based on these press releases. The researchers documented that the suggestions they made for the press releases had transferred over to the media articles. Specifically, the researchers found that the media articles based on press releases with aligned language had more aligned language than media articles based on press releases that had not undergone any changes. Additionally, the researchers found that the media articles based on

press releases with a caveat were more likely to have a caveat than media articles based on press releases that had not undergone any changes. These findings, paired with Yavchitz and colleagues' (2012) findings, suggest that misrepresentation in the original source – often the scientific journal article – may be driving the misrepresentation in media articles and press releases.

**Causal misinterpretation in scientific journal articles.** Because misinterpretation of causation from correlation in media articles and press releases may stem from misinterpretation in the original source – the scientific journal article (Adams et al., 2019; Yavchitz et al., 2012) – it is important to understand the rate of causal misinterpretation in scientific journal articles. In fact, researchers have tackled this question in scientific medical/health journals (Brown et al., 2013; Cofield et al., 2010; Lazarus et al., 2015; Li et al., 2009), education journals (Reinhart et al., 2013; Robinson et al., 2007), and psychology journals (Bleske-Rechek et al., 2018). In medical/health journals, although the authors of this discipline are researchers by trade, the misinterpretation of causation from correlation is higher than would be expected (Brown et al., 2013; Cofield et al., 2010; Lazarus et al., 2015; Li et al., 2009). For example, Cofield and colleagues (2010) investigated the misinterpretation of causation from correlation in 525 non-experimental articles published during 2006 in the top four nutrition and dietetics journals. Along with recording descriptive information about the article (e.g., study design, source of funding), the researchers read through the title and abstract of each article and identified if causal language was either used or not used in each of these sections. Across all four journals, the researchers found that 31% of the articles used inaccurate causal language in the title, 7% did so in the abstract, and 39% did so in both the title and abstract. Lazarus and colleagues (2015) also investigated the inaccurate use of causal language in 128 non-experimental articles published

during 2011-2013 in 25 journals from the BioMed Central Medical Series covering a variety of topics. After collecting these non-experimental articles, the researchers recorded descriptive information about the article (e.g., study design, sample size, funding source) and documented the misrepresentation (including inaccurate causal language) that appeared in the article abstract. Lazarus and colleagues documented that 84% of the articles had at least one type of misrepresentation in the abstract. Moreover, the most common type of misrepresentation was inaccurate causal language (53% of abstracts). With these findings as evidence, it is clear that causal misinterpretation is not only pervasive in media articles and press releases, but in medical/health journals as well.

Causal misinterpretation is also pervasive in education journals (Reinhart et al., 2013; Robinson et al., 2007). Robinson and colleagues (2007) examined misinterpretation of causation from correlation in five teaching journals during 1994 and 2004. First, the research team coded each article's design as intervention, correlational, qualitative, or descriptive. Because causal language could only be used with intervention studies, the researchers focused on the studies for which causal language could not be used (i.e., correlational, qualitative, and descriptive; N = 274). Next, to assess the rate of causal misinterpretation, the researchers read through the abstract and discussion for each of the non-intervention studies to look for any causal statements. Across all five journals, Robinson and colleagues found that 34% of non-intervention studies misinterpreted causation from correlation in 1994 and 43% did so in 2004. Reinhart and colleagues (2013) sought to extend this research by investigating the rate at which causal misinterpretation was used in education journals in 2000 and 2010. In order to produce similar results, Reinhart and colleagues collected their articles from the same five journals used by Robinson and colleagues (2007) and followed the same coding procedure. Across all five

journals, they found that 41% of non-intervention studies misinterpreted causation from correlation in 2000 and 46% did so in 2010.

Recently, causal misinterpretation has been documented in psychology journals as well. Specifically, Bleske-Rechek and colleagues (2018) reviewed 660 scientific articles retrieved from 11 psychology journals of varying topics and impact factors. These researchers coded whether each article had causal language in the title and/or the abstract. Additionally, if causal language was present, the researchers reviewed the rest of the article to determine if the research design explained in the article supported the causal language used. The researchers found that causal language was present (in either titles or abstracts) for 54% of journal articles. Moreover, of the articles that used causal language, 52% did so inaccurately because they only measured (not manipulated) the variable in question. Interestingly, these researchers also documented that, although not related to overall use of causal language, impact factor was negatively related to inaccurate use of causal language. That is, causal misinterpretation was less likely in a journal of a higher impact factor.

Because causal misinterpretation has been documented from the general public to scientific journal articles, it is interesting that no research has yet documented causal misinterpretation for a group of individuals who are trained to teach students a variety of subject areas – educators. For this reason, the current study will investigate the rate at which educators use inaccurate causal language to describe non-causal research descriptions. Given the pervasiveness of causal misinterpretation in the public and across published scientific literature, it is hypothesized that educators will also misinterpret causation from correlation.

# Chapter II: Methodology

The current study aims to address a gap in the literature assessing the degree to which K-12 teachers and college instructors generate and select inaccurate causal language from non-causal research descriptions. Although causal thinking has been called a persistent bias of human cognition (Kahneman, 2011; Stanovich, 2009), no previous research has examined whether educators fall prey to this misinterpretation just as other people do. For this reason, educators were the sample population used for this study.

## Participants

A total of 278 educators responded to the survey using two recruitment methods (email invitations and crowdsourcing via Prolific; email n = 78, Prolific n = 200). After removing 55 participants who gave incomplete responses, the data from 223 participants were used for analyses. These participants were primarily female (69%), white (92%), and well educated (45% held bachelor's degrees, 26% held master's degrees, 3% held professional degrees, and 20% held doctoral degrees). Additionally, on average, these participants were middle-aged ($M$ = 40.05, $SD$ = 10.96) and had taught for over a decade ($M$ = 12.23, $SD$ = 8.74). Participants worked in a variety of different teaching environments and taught a variety of different subject areas (see **Error! Reference source not found.**). These participants spent the majority of their day teaching ($M$ = 57%, $SD$ = 1.67). However, they also spent parts of their day doing research ($M$ = 18%, $SD$ = 1.24), advising ($M$ = 13%, $SD$ = 0.89), and other activities ($M$ = 13%, $SD$ = 1.05).

Table 1

*Percentage of Participants Teaching in Each Environment and Subject Area*

| Teaching Environment | Percentage | Subject Area | Percentage |
|---|---|---|---|
| Elementary School | 25% | Social Science | 21% |
| Middle School | 9% | Early Years | 17% |
| High School | 23% | STEM | 15% |
| Tribal College | 2% | English | 14% |
| Special Focus Institution | 1% | Foreign Language | 8% |
| Two Year College | 3% | Multiple Subjects | 8% |
| Four Year College | 8% | Life Skills | 4% |
| Master's University | 5% | Special Education | 5% |
| Doctoral University | 11% | Arts | 3% |
| Other | 14% | Physical Education | 3% |
| | | Business | 2% |

## Materials

Following the design of previous studies (Bleske-Rechek et al., 2015; Norris et al., 2003), participants were asked to read and react to two brief research descriptions (see Appendix A). However, unlike previous studies, a false cover story was used. Specifically, participants were told that this study was looking at how educators interpret parenting research in the media. Each section of the study is detailed further in the sections below.

**Research descriptions.** The research descriptions used were adapted from two studies published in peer-reviewed journal articles, one on parent support groups (Matthews, 2009) and the other on helicopter parenting (Schiffrin & Liss, 2017). Both research descriptions were modified to include a description of (1) the sample size, (2) the study design, and (3) the findings

to ensure that participants had enough information about the study. All participants read both research descriptions (see Appendix A); however, the order in which participants saw the research descriptions was counterbalanced. That is, some participants read Research Description 1 first whereas other participants read Research Description 2 first. Research Description 1 details a non-randomized, post-test only, descriptive study with positive findings about parent support groups. Research Description 2 details a non-randomized, cross-sectional, correlational study with negative findings about helicopter parenting. Because previous research has documented that individuals interpret causality in line with their individual beliefs, even if it goes against the study description (Bleske-Rechek et al., 2015), it was important to include both a topic that individuals might interpret positively (i.e., parent support groups) as well as a topic that individuals might interpret negatively (i.e., helicopter parenting). Although one research description describes positive findings and the other describes negative findings, the rate at which causal headlines were used to describe the research was expected to be the same for both research descriptions. Moreover, in both research descriptions, the study design did not warrant causal language. Therefore, any causal language used by the participants was inaccurate.

**Media headlines.** After reading each research description, participants were first asked to generate their own short, accurate media headline that referenced the two variables of interest described in the research (e.g., parent support group participation & parenting behaviors) and their relationship. Then, on a new screen, participants were asked to select any appropriate media headlines from a list of four options provided by the researcher. The options contained four different types of causal language: directly causal (e.g., promote), can causal (e.g., can promote), correlational (e.g., is associated with), and conditional correlational (e.g., may be associated with; see Appendix A). These four levels of causal statements were selected because previous

research has documented that individuals differentiate the level of causality among the four with direct causal being perceived as the most causal followed by can causal, correlational, and conditional correlational which is perceived as the least causal (Adams et al., 2017). Additionally, these four levels of causal statements were selected because two are accurate (i.e., correlational & conditional correlational) and two are inaccurate (i.e., directly causal & can causal) based on the non-causal research described.

The rate at which educators use inaccurate causal language can be assessed from both their creation and selection of media headlines. However, creation is organic and real-to-life (e.g., figuring out what to title an article) whereas selection is inorganic and more aligned with a structured test (e.g., testing understanding about correlation and causation in a research methodology course). No previous research has investigated if these different outcomes will generate different levels of inaccurate causal language. Therefore, the rate of inaccurate causal language will be calculated for each outcome.

**Parenting opinions.** Next, in order to identify if individuals actually interpreted causality in line with their individual beliefs, even if it went against the study description (Bleske-Rechek et al., 2015), participants were asked to report the degree to which they believed each of the parenting topics (i.e., parent support group participation & helicopter parenting) were positive parenting behaviors on a 1 (*Strongly Disagree*) to 5 (*Strongly Agree*) scale (see Appendix B).

**Demographics.** Then, participants were asked to report their gender, race, age, education level, years teaching in the field, area of instruction, typical work distribution, and institution type (see Appendix C).

**Cover story success.** In order to assess if the false cover story about parenting research in the media worked in this study, at the end of the questionnaire, following the demographics,

participants responded to one final question (see Appendix D). This question was used to assess if individuals who suspected that this study was investigating the accuracy of language used to describe the results of a study performed better than did those who did not suspect that this study was investigating the accuracy of language used to describe the results of a study.

**Procedure**

After receiving approval from the University of Wisconsin-Stout's Institutional Review Board, educators were invited to participate in this study either through an email invitation or a posting via Prolific. Educators who were invited to participate via email were identified because they had recently published a journal article in a psychological journal. Educators who were invited to participate via Prolific were identified because they had indicated that they worked in the education industry and their job involved teaching. Upon clicking a link to the survey, all participants were taken to the same online survey (hosted via Qualtrics) where they read through a cover letter about the study and then, if they consented to participate, they continued on to the survey. In order to ensure that participants did not follow both forms of recruitment, the ballot box stuffing feature of Qualtrics was used to prevent an individual with the same IP address from participating in the survey more than once. After completing the survey, all participants were debriefed and informed that the study they had just participated in was actually researching the rate at which educators use inaccurate causal language to describe the results of a study. On average, it took participants about 10 minutes to finish the study ($M = 8.57$, $SD = 5.00$).

# Chapter III: Results

Although no previous studies have investigated educators' use of inaccurate causal language, because causal thinking is a pervasive bias, it was hypothesized that educators would still misinterpret causation from correlation. To measure misinterpretation of causation from correlation, participants were asked to both generate and select headlines that they thought accurately portrayed the research descriptions that they had just read. Because both of the research descriptions described non-causal data, any generated or selected headlines with causal language was inaccurate.

## Causal Language in Generated Headlines

The headlines generated by participants were coded to identify (1) what type of language the participant used and (2) if this language was inaccurate causal language. To identify the type of language the participant used, each headline was read by the first author and coded to indicate which of the six causal expressions identified by Adams and colleagues (2017) was included in the headline (i.e., direct causal, can causal, conditional causal, ambiguous, correlational, or conditional correlational). Additionally, beyond Adams' six categories, four other categories were used to identify unique ways participants generated headlines. These additional categories included: non-specific causal language (i.e. headlines with language that assumes a causal impact, but does not directly reference it), group comparison (i.e., headlines that contain a comparison of results between two groups), question format (i.e., headlines posed in the form of a question), and no reference to variable relationship (i.e., headlines that do not address the relationship between the two variables). See **Error! Reference source not found.** for example headlines that were coded into each mutually exclusive category. Next, because both of the research descriptions described non-causal data, any headlines with causal language were

inaccurate. Therefore, after the type of language used was identified, any headlines containing causal language (i.e., direct causal, can causal, conditional causal, or non-specific causal statements) were coded as inaccurate and any headlines containing non-causal language (i.e., ambiguous, correlational, conditional correlational, group comparison, question format, or no reference to variable relationship) were coded as accurate.

When generating headlines for both research descriptions, many participants used direct causal or non-specific causal language while the other language types were less frequently used (see **Error! Reference source not found.** for percentages used). Digging deeper into the accuracy behind the type of language used, for the parent support group headlines, 71% of participants used inaccurate causal language whereas 29% did not. Additionally, for the helicopter parenting headlines, 69% of participants used inaccurate causal language whereas 31% did not.

Table 2

*Categories of Language Use in Participant Generated Headlines*

| | Type of Language Used | Example | Parent Support Group Headlines | Helicopter Parenting Headlines |
|---|---|---|---|---|
| Inaccurate Causal Language | Direct Causal | "Parent Support Group **Promotes** Good Parenting" | 43% | 41% |
| | Can Causal | "Helicopter Parents **Can Impact** Future Academic Motivation" | 4% | 5% |
| | Conditional Causal | "Parent support groups **may improve** parenting behaviors" | 4% | 7% |
| | Non-specific Causal | "Helicopter Parenting Does Not Help Students" | 20% | 16% |
| Accurate Non-Causal Language | Ambiguous | "Students with Helicopter Moms **tend to** have More Maladaptive Academic Motivations" | 1% | 5% |
| | Correlational | "Parent support group participation is **associated with** nurturing parenting behaviors" | 4% | 7% |
| | Conditional Correlational | "Helicopter parenting **may be associated with** academic apathy." | 1% | 1% |
| | Group Comparison | "Parents participating in a parent support group report more nurturing parenting behaviors than parents who did not participate in this support group" | 11% | 5% |
| | Question Format | "Helicopter parenting, does it **make** your child a better learner?" | 2% | 6% |
| | No Reference to Variable Relationship | "Parents and Attitudes" | 11% | 8% |

Looking at both research descriptions, participants generated more inaccurate causal and less accurate non-causal language than expected (parent support groups: $\chi^2$ (1, 222) = 39.80, $p$ < .001, φ = .42; helicopter parenting: $\chi^2$ (1, 221) = 32.69, $p$ < .001, φ = .38). When comparing the two research descriptions, participants who used non-causal language in one research description used more non-causal language than expected in the other research description ($\chi^2$ (1, 220) = 15.40, $p$ < .001, φ = .27). That is, if educators generated a headline with accurate non-causal language to describe the helicopter parenting research, they also used more accurate non-causal language than expected in the parent support group headlines that they generated.

Because the usage of non-causal language in one research description was related to the usage of non-causal language in the other research description, participants' inaccurate causal language use from both the parent support group and helicopter parenting research descriptions were combined. Specifically, participants were coded as having inaccurate causal language in no headlines, one headline, or both headlines. When looking at the rate of inaccurate causal language use across both research descriptions, more participants than expected used inaccurate causal language in both of the headlines that they generated ($\chi^2$ (2, 220) = 53.38, $p$ < .001, φ = .49). Specifically, 15% of educators used inaccurate causal language in no headlines, 31% did so in one headline, and 55% did so in both headlines. See **Error! Reference source not found.**.

Looking at the rate of inaccurate causal language used in the headlines generated for this study compared to the average documented rate of inaccurate causal language in the literature, neither the rate of causal language used for the parent support group (71% [95% CI: 65, 77]) or the helicopter parenting research descriptions (69% [95% CI: 63, 75]) overlapped with the overall average of all the documented uses of inaccurate causal language in the literature (41%). In fact, the rates documented in this study were higher than the overall average. See Figure 1.

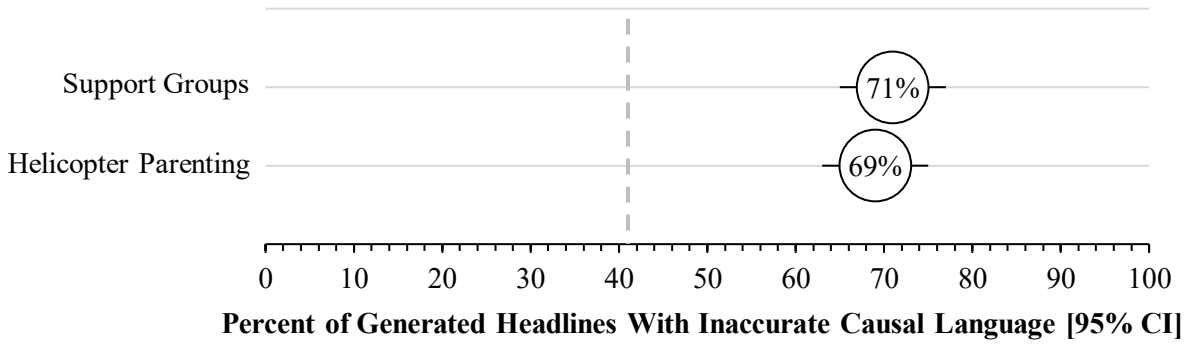


*Figure 1.* Percentage of participants who generated headlines with inaccurate causal language.

*Note*. Each dot represents a point estimate and each horizontal line its corresponding 95% CI. The dashed vertical line represents the overall average of inaccurate causal language used in the literature (41%). This average was calculated by averaging the rate of inaccurate causal language reported by Bleske-Rechek and colleagues (2018), Cofield and colleagues (2010), Lazarus and colleagues (2015), Reinhart and colleagues (2013), Robinson and colleagues (2007), Sumner and colleagues (2014), and Sumner and colleagues (2016).

**Causal Language in Selected Headlines**

When asked to select any of the four headlines that provided an appropriate description for the parent support group research description, participants selected all four headlines at about the same rate. However, when asked to select any of the four headlines that provided an appropriate description for the helicopter parenting research description, fewer participants selected the directly causal headline and more selected the conditional correlational headline (see **Error! Reference source not found.**).

Table 3

*Rates of Selecting Each Headline Type*

| | Research Description | |
|---|---|---|
| Headline Type | Support Groups | Helicopter Parenting |
| Directly Causal | 39% | 18% |
| Can Causal | 45% | 38% |
| Correlational | 34% | 39% |
| Conditional Correlational | 40% | 53% |

Because both research descriptions describe non-causal data, the directly causal and can causal headlines contain inaccurate causal language whereas the correlational and conditional correlational headlines contain accurate non-causal language. When selecting a headline to describe the parent support group research description, 66% of participants selected at least one headline that contained inaccurate causal language (i.e., they selected the directly causal and/or can causal headline) whereas 34% did not (i.e., they only selected the correlational and/or conditional correlational headline). Looking the rate of selected inaccurate versus accurate parent support group headlines, participants selected more inaccurate causal titles and less accurate correlational titles than expected ($\chi^2$ (1, 223) = 23.90, $p < .001$, $\varphi = .33$). When selecting a headline to describe the helicopter parenting research description, 48% of participants selected at least one headline that contained inaccurate causal language whereas 52% did not. For the helicopter parenting headlines, there were no significant differences between the rate of selected inaccurate versus accurate headlines ($\chi^2$ (1, 223) = 0.22, $p = .639$, $\varphi = .03$).

When comparing the two research descriptions, participants who selected headlines with inaccurate causal language in one research description selected more inaccurate headlines and

fewer accurate headlines than expected in the other research description ($\chi^2$ (1, 223) = 47.59, $p$ < .001, φ = .46). That is, if educators selected a headline with inaccurate causal language to describe the parent support group research, in the helicopter parenting research description, they also selected more inaccurate causal language and less accurate causal language than expected. Additionally, the same finding applied in the opposite direction. That is, educators who selected a headline with inaccurate causal language to describe the helicopter parenting research description also selected more inaccurate causal language and less accurate causal language than expected to describe the parent support group research description.

Again, because the usage of causal language in one research description was related to the usage of causal language in the other research description, participants' selection of inaccurate causal language from both the parent support group and helicopter parenting research descriptions were combined. When selecting headlines for each research description, participants had the option to select up to two inaccurate causal headlines. Therefore, combining these, participants were coded as selecting inaccurate causal language in no headlines, one headline, two headlines, three headlines, or four headlines. When looking at the rate of inaccurate causal language selected across both research descriptions, fewer participants than expected selected three or four headlines that contained inaccurate causal language ($\chi^2$ (4, 223) = 57.70, $p$ < .001, φ = .51). Specifically, 28% of educators selected inaccurate causal language in no headlines, 27% did so in one headline, 30% did so in two headlines, 8% did so in three headlines, and 7% did so in all four headlines.

Looking at the rate of inaccurate causal language in the selected headlines for this study compared to the average documented rate of inaccurate causal language in the literature, neither the rate of inaccurate causal language selected for the parent support group (66% [95% CI: 60,

73]) or the helicopter parenting research descriptions (48% [95% CI: 42, 55]) overlapped with the overall average of all the documented uses of inaccurate causal language in the literature (41%). In fact, the rates documented in this study were higher than the overall average. See Figure 2.

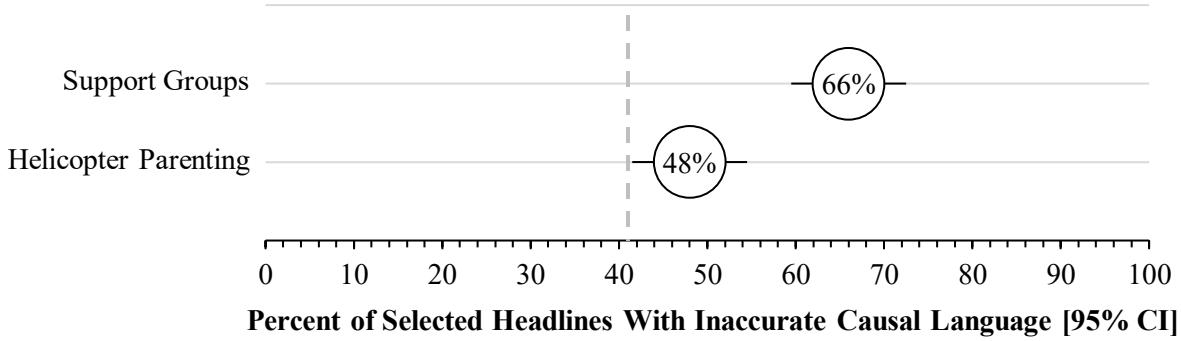


*Figure 2*. Percentage of participants who selected at least one headline with inaccurate causal language. *Note.* Each dot represents a point estimate and each horizontal line its corresponding 95% CI. The dashed vertical line represents the overall average of inaccurate causal language used in the literature (41%). This average was calculated by averaging the rate of inaccurate causal language reported by Bleske-Rechek and colleagues (2018), Cofield and colleagues (2010), Lazarus and colleagues (2015), Reinhart and colleagues (2013), Robinson and colleagues (2007), Sumner and colleagues (2014), and Sumner and colleagues (2016).

**Relationship Between Causal Language and Additional Variables**

Because causal thinking is a persistent bias, beyond understanding the rate at which inaccurate causal language is used, it is also important to understand what variables are related to this language use. For this reason, the relationship between accuracy of language used and educators' (1) opinions toward parenting practices, (2) education level, (3) subject area taught, (4) perception of the study purpose, and (5) time spent on the survey were explored. Findings from these analyses can be found in **Error! Reference source not found.** and

below.

**Opinions of parenting practices and causal language use.** It is possible that the accuracy of language that participants generated or selected may be associated with their opinions on the parenting practices. For this reason, participants were asked to report their opinions on both parent support groups and helicopter parenting. On average, participants felt somewhat positively about parent support groups ($M$ = 4.14, $SD$ = 0.05) and somewhat negatively about helicopter parenting ($M$ = 2.26, $SD$ = 0.06). However, these opinions had few statistical associations with the accuracy of language used. In fact, in the participant generated headlines, there was no relationship between support group opinion and use of inaccurate causal language ($\chi^2$ (4, 221) = 8.96, $p$ = .062, φ = .20) or type of causal language used ($\chi^2$ = (36, 221) 42.16, $p$ = .222, φ = .44) or between helicopter parenting opinion and use of inaccurate causal language ($\chi^2$ (4, 221) = 5.58, $p$ = .233, φ = .16) or type of causal language used ($\chi^2$ (36, 221) = 36.17, $p$ = .461, φ = .41). Additionally, in the selected headlines, there was no relationship between helicopter parenting opinion and selecting accurate headlines ($\chi^2$ (4, 223) = 2.17, $p$ = .705, φ = .01). There was, however, a significant relationship between support group opinion and selecting accurate headlines ($\chi^2$ (4, 222) = 19.76, $p$ = .001, φ = .30). Specifically, individuals who felt neutral about parent support groups selected more correlational headlines than expected.

**Education level and causal language use.** Previous research has documented that education level is associated with scientific literacy (Miller, 2016). However, other research has documented that education level is not associated with accurate use of causal language (Bleske-Rechek et al., 2015; Norris et al., 2003). For this reason, the relationship between level of education and use of inaccurate causal language was investigated. To look at this relationship, participants were grouped into one of three categories: some college or less (associate's and

below), bachelor's, or advanced (master's and above). Unsurprisingly, education level was not related with the accuracy of language generated ($\chi^2$ (4, 220) = 4.86, $p$ = .302, φ = .15; see **Error! Reference source not found.**) or selected ($\chi^2$ (8, 223) = 15.27, $p$ = .054, φ = .26; see

).

Table 4

*Inaccurate Causal Language Use Across Participant Generated Headlines*

| | Number of Inaccurate Causal Headlines Generated Across Both Research Descriptions | | |
|---|---|---|---|
| | 0 | 1 | 2 |
| All Educators (n = 220) | 15% | 31% | 55% |
| Some College or Less (n = 14) | 7% | 36% | 57% |
| Bachelor's (n = 99) | 10% | 30% | 60% |
| Advanced (n =107) | 20% | 31% | 50% |
| Early Years (n = 35) | 6% | 29% | 66% |
| STEM (n = 30) | 10% | 27% | 63% |
| English (n = 29) | 3% | 28% | 69% |
| Social Sciences (n = 45) | 44% | 27% | 29% |
| Guessed Study Purpose (n = 25) | 40% | 32% | 28% |
| Did Not Guess Study Purpose (n = 177) | 12% | 29% | 59% |
| Lowest 25% Time Spent (n = 55) | 16% | 42% | 42% |
| Highest 25% Time Spent (n = 55) | 13% | 28% | 59% |

Table 5

*Inaccurate Causal Language Use Across Selected Headlines*

| | Number of Inaccurate Causal Headlines Selected Across Both Research Descriptions | | | | |
|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 |
| All Educators (n = 223) | 28% | 27% | 30% | 8% | 7% |
| Some College or Less (n = 14) | 7% | 36% | 50% | 0% | 7% |
| Bachelor's (n = 101) | 21% | 30% | 33% | 11% | 6% |
| Advanced (n =108) | 38% | 22% | 25% | 7% | 8% |
| Early Years (n = 36) | 19% | 36% | 22% | 8% | 14% |
| STEM (n = 32) | 19% | 25% | 50% | 6% | 0% |
| English (n = 29) | 17% | 21% | 38% | 7% | 17% |
| Social Sciences (n = 45) | 60% | 20% | 18% | 0% | 2% |
| Guessed Study Purpose (n = 25) | 68% | 8% | 12% | 8% | 4% |
| Did Not Guess Study Purpose (n = 180) | 22% | 29% | 32% | 9% | 7% |
| Lowest 25% Time Spent (n = 55) | 27% | 40% | 30% | 7% | 6% |
| Highest 25% Time Spent (n = 55) | 24% | 30% | 40% | 7% | 9% |

**Subject area taught and causal language use.** Because certain disciplines are given specific training in the difference between causation and correlation (American Psychological Association, 2013; McGovern et al., 1991), the relationship between subject area taught and use of inaccurate causal language was investigated. To look at this relationship, participants from the top four subject areas – early years, STEM, English, and social sciences – were used for analysis. Interestingly, the subject area that participants taught was related with the accuracy of language

generated and selected. Specifically, when asked to generate headlines, participants who taught social sciences used more accurate non-causal language than expected ($\chi^2$ (6, 139) = 31.79, $p$ < .001, φ = .48; see **Error! Reference source not found.**). Additionally, when asked to select headlines, participants who taught social sciences selected more accurate non-causal headlines than expected ($\chi^2$ (12, 142) = 39.64, $p$ < .001, φ = .53; see

). However, it is important to note that individuals who taught social sciences also guessed the purpose of the study at a higher rate than expected ($\chi^2$ (3, 129) = 16.64, $p$ = .001, φ = .36).

**Guessing the study purpose and causal language use.** Educators are a unique sample population because they may have learned about the difference between causation and correlation during their education and/or they themselves may teach this subject to their students. Because of this, it is likely that some participants will guess the purpose of the study. In fact, 12% of participants did indeed guess the purpose of the study. Interestingly, guessing the purpose of the study was related with the accuracy of language generated and selected. Specifically, when asked to generate headlines, participants who guessed the purpose of the study used more accurate non-causal language than expected ($\chi^2$ (2, 202) = 15.25, $p$ < .001, φ = .28; see **Error! Reference source not found.**). Additionally, when asked to select headlines, participants who guessed the purpose of the study selected more accurate non-causal headlines than expected ($\chi^2$ (4, 205) = 23.68, $p$ < .001, φ = .34; see

).

**Time spent on survey and causal language use.** On average, it took participants about 10 minutes to finish the study ($M$ = 8.57, $SD$ = 5.00). However, the amount of time that individuals spent on the survey highly varied. Indeed, the fastest participant finished the survey in 2.8 minutes whereas the slowest participant finished the survey in 38.8 minutes. Participants who spent more time on the survey could have taken longer to reflect on their language to ensure that it was accurate. For this reason, the relationship between time spent on the survey and use of inaccurate causal language was investigated. To look at this relationship, participants were separated into four equal group (i.e., quartiles) and the lowest 25% (the individuals who took the survey the fastest) and the highest 25% (the individuals who took the survey the slowest) were compared. Time spent on the survey was not related with the accuracy of language generated ($\chi^2$ (2, 109) = 3.40, $p$ = .183, φ = .18; see **Error! Reference source not found.**) or selected ($\chi^2$ (4, 110) = 7.98, $p$ = .092, φ = .27; see

).

## Chapter IV: Discussion

The purpose of this study was to investigate the rate at which educators use inaccurate causal language. This was investigated by having 223 educators read non-causal research descriptions about parenting topics and then generate and select headlines that would accurately describe the research that they read. The following section will summarize the results of this approach and then go on to talk about their implications, as well as limitations of this study and future directions for causal language research.

After having participants read non-causal research descriptions about parent support groups and helicopter parenting, 71% and 69% of participants used inaccurate causal language when generating headlines to describe these research descriptions, respectively. Likewise, 66% and 48% of participants selected at least one headline that contained inaccurate causal language to, respectively, describe the parent support group and helicopter parenting research descriptions. Additionally, for both research descriptions, participants generated more inaccurate causal headlines and less accurate non-causal headlines than expected. Moreover, the rate at which participants generated and selected inaccurate causal language was higher than the average of other reported rates in the literature (Bleske-Rechek et al., 2018; Cofield et al., 2010; Lazarus et al., 2015; Reinhart et al., 2013; Robinson et al., 2007; Sumner et al., 2014; Sumner et al., 2016).

These findings suggest that educators used inaccurate causal language at a rate that was greater than chance alone. That is, along with the general public (Bleske-Rechek et al., 2015) and students (Norris & Phillips, 1994; Norris et al., 2003), educators also fall prey to the causal thinking bias. Although these findings are concerning, it is not surprising. Researchers have documented that causal thinking develops early (Cohen & Amsel, 1998) and some have even deemed it a persistent bias of human cognition (Kahneman, 2011; Stanovich, 2009). However,

the current research is helpful because it continues to document just how persistent causal thinking may be.

To further investigate educators' use of inaccurate causal language, the relationship between accuracy of language used and educators' (1) opinions toward parenting practices, (2) education level, (3) subject area taught, (4) perception of the study purpose, and (5) time spent on the survey were explored. Interestingly, participants' parent support group and helicopter parenting opinions, education level, and time spent on the survey were not reliably tied to the accuracy of their responding. This suggests again that causal thinking is a persistent bias and is present regardless of opinion toward a topic, education level, or time spent reflecting on language use. On the other hand, participants who correctly guessed the purpose of the study or taught social sciences used more accurate non-causal language than expected. This is a hopeful finding because it suggests that if educators are able to identify a situation related to causal language and/or they have been trained in understanding the difference between causation and correlation, they may be more likely to use accurate language.

**Practical Implications**

This is the first study to document that educators, in addition to the general public (Bleske-Rechek et al., 2015), students (Norris & Phillips, 1994; Norris et al., 2003), media articles (Cooper et al., 2011; Haneef et al., 2015; Schwitzer, 2008), press releases (Sumner et al., 2014; Sumner et al., 2016), and scientific journal articles (Bleske-Rechek et al., 2018; Lazarus et al., 2015; Robinson et al., 2007), use inaccurate, unwarranted causal language at a high rate. This finding adds evidence to the claim that causal thinking is a persistent bias of human cognition (Kahneman, 2011; Stanovich, 2009) that all individuals fall prey to. Although this bias is persistent, individuals in this study who were able to identify a situation related to causal

language or had been trained in understanding the difference between causation and correlation used more appropriate non-causal language than expected. With this in mind, one general implication for all individuals is to seek out education on (1) the difference between causation and correlation and (2) when each type of language is warranted by the research it is describing. Although just a start, gaining awareness (or refreshing awareness) about the difference between causation and correlation may help increase the accuracy of language people use when describing their own and others' research findings. Consider the game of telephone where one person starts with a statement and as it gets passed from individual to individual it gets more and more distorted. The same thing occurs when individuals use inaccurate causal language to describe their own or others' research findings. For example, if an author publishes research findings with inaccurate causal claims, the message is already distorted and will become more and more distorted as these findings are cited by others and talked about in the media. If individuals seek out education on using accurate causal language, they can combat the distortion that is created from the "telephone game" and instead allow the accurate message to prevail. In addition to this general implication, these findings have specific implications for a number of stakeholders discussed in the sections below.

The first group of stakeholders includes researchers who are creating primary knowledge. The findings here suggest that there is a need to investigate the misinterpretation of causation from correlation within the research community. Often, researchers will use students or convenience samples to test out theories, but, moving forward, researchers should also create and test theories on themselves in order to investigate what differences may exist in their own subject group. That is, this may be one example of a bias blind spot in that researchers do not realize that they succumb to the causal thinking bias as much as everyone else does. Additionally,

researchers may benefit from training in headline creation. When disseminating primary knowledge via journal articles, researchers are asked to create catchy titles that accurately describe their research. In the journalistic world, specific principles are used by professional writers to create effective and accurate headlines (Saxena, 2006), but it is unlikely that researchers get this same training. Because previous research has documented that media stories based on press releases with accurate headlines had more accurate headlines than other media stories (Adams et al., 2019), researchers should arm themselves with professional journalistic principles in order to learn how to create accurate article titles and improve not only the accuracy of their own causal language, but that of others.

The second group of stakeholders includes educators. The findings here suggest that all educators – not just those who teach sciences – should assess the language that they are using to describe research with students and colleagues. Students may observe the language that their educators use (whether accurate or inaccurate) and make assumptions about the way that they should talk about research. Although just one small part of their daily responsibilities, educators are responsible for helping students understand and combat their biases. Perhaps adjusting the language that educators use may help students deal with their causal thinking bias and improve the poor scientific literacy in the U.S. (Miller, 2016).

The third group of stakeholders includes students from all disciplines. The findings here suggest that students should critically digest information both in their academic and personal lives. Because causal thinking is such a persistent bias, it is likely that students will come across inaccurate language in their studies. With this in mind, students should remain curious and critical through their learning, be confident enough to challenge things that they think might be inaccurate, and be persistent enough to find the true answer. In addition, it is important for

students to remember that previous research has documented that they are also likely to use inaccurate causal language (Norris & Phillips, 1994; Norris et al., 2003). For this reason, it is also important that students take time during their studies to learn more about when to use causal language and when not to.

**Limitations**

This is the first study to document that educators also fall prey to the causal thinking bias and use inaccurate causal language. However, it is not without limitations. Specifically, the use of media headlines, coding of causal language, and the use of Prolific as a recruitment source may have limitations for the findings of this study. First, in order to disguise the purpose of the study, a cover story about parenting research in media headlines was used. Although this cover story was effective (only 12% of participants guessed the actual study purpose), the reference to media headlines may have been problematic. Specifically, although professional writers have specific principles that they use to create effective and accurate headlines (e.g., use simple, short, concrete and appropriate words; avoid auxiliary verbs; use verbs correctly; and do not imply meanings; Saxena, 2006), research shows that readers do not find the headlines that follow these principles interesting (Ifantidou, 2009). Additionally, other research has documented that, in fact, real-life headlines do not accurately represent the article content that they introduce (Andrew, 2007). For these reasons, it is possible that educators (who may not be professional writers) generated and selected inaccurate headlines at a higher than average rate because (1) they focused on creating interesting rather than accurate headlines and/or (2) they matched their headlines to others that they have seen in the media. Further research should be done to see if educators still use inaccurate causal language at a higher than average rate when generating and selecting items other than media headlines.

Second, this study may actually underestimate the use of inaccurate causal language. Specifically, headlines generated by participants in the form of a question (e.g., "Helicopter parenting, does it make your child a better learner?") were not coded as causal because the question format suggests an investigation into a topic rather than a certain causal claim. However, many question format headlines did contain causal language (e.g., "make" in the example above) and may be interpreted as such by other readers. Additionally, both ambiguous (e.g., is linked to) and correlational (e.g., is associated with) language were coded as accurate non-causal language because, currently, this is the way that scientists communicate non-causal correlational findings. However, research suggests that other readers may interpret this language as causal (Adams et al., 2017). For both of these reasons, the actual rate of causal language used by educators may be higher than the percentages documented here.

Third, this study used Prolific as a primary source of recruitment. Although research has shown that the data obtained from Prolific are a similar quality to data obtained from Amazon Mechanical Turk (MTurk; Peer et al., 2017), there are also some key differences between the two platforms. Specifically, most MTurk participants live in North America (U.S. and Canada; Peer et al., 2017), whereas Prolific participants are based around the world with the majority living in either the U.K. (40%) or the U.S. (32%; Prolific, 2020). Although this additional diversity gained through Prolific is beneficial, these different regions may also have differences in how they use or interpret causal language – a key component of this study. Therefore, future research should investigate the ways in which people in different regions use or interpret causal language.

**Future Directions**

Beyond the future directions for research listed above (i.e., educators' use of inaccurate causal language in items other than media headlines and regional differences in causal language

use/interpretation), it is interesting to explore the findings that participants who correctly guessed the purpose of the study or taught social sciences used more accurate non-causal language than expected. In line with this finding, future research should investigate both the rate at which individuals who get specific training in causation and correlation use inaccurate causal language as well as teaching methodologies that may help individuals who have not received this specific training identify, use, and interpret causal language.

First, because psychology professors get specific training in the difference between causation and correlation (American Psychological Association, 2013; McGovern et al., 1991) they would be an interesting sample to replicate this study with. By comparing psychology professors' results to the results of the educators in this sample, future researchers could investigate if individuals with additional training in causation and correlation have different levels of inaccurate causal language use compared to a general sample of educators.

Second, more research needs to be done on teaching methodologies that may help individuals who have not received specific training on identifying, using, and interpreting causal language. Cascio (2017) showed that after using 4 repetitious classroom activities in which students read and analyzed short psychological studies using 10 critical thinking questions every 3-4 weeks for a semester, students' critical thinking scores increased from the first to final activity. This study suggests that critical thinking can be taught, and implies that understanding the circumstances and language for causal versus non-causal patterns can be taught, too. Additionally, it is one of many potential teaching methodologies that may help individuals identify, use, and interpret causal language. More research needs to be done to identify other potential teaching methodologies.

## Conclusion

The current study investigated the rate at which educators used inaccurate causal language when generating and selecting headlines to describe non-causal parenting research descriptions. The results from this study suggest that, unsurprisingly, educators do fall prey to the causal thinking bias. In fact, 71% and 69% of participants used inaccurate causal language when generating headlines to describe the support group and helicopter parenting research descriptions, respectively. Likewise, 66% and 48% of participants selected at least one headline that contained inaccurate causal language to describe the support group and helicopter parenting research descriptions, respectively. Moreover, the rate at which educators used and selected inaccurate causal language was higher than the average of other reported rates in the literature. Interestingly, educators' opinions towards the parenting practices, education level, and time spent on the survey had few statistical associations with the accuracy of language used. On the other hand, educators who correctly guessed the purpose of the study or taught social sciences used more accurate non-causal language than expected. These results should be used by all individuals as inspiration to seek out education on (1) the difference between causation and correlation and (2) when each type of language is warranted by the research it is describing.

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## Appendix A: Questionnaire Questions

**Because research on parenting is popular in the media, we are interested how you think about portrayals of parenting research in the media. Please read the following parenting research descriptions and respond to the questions.**

*Research Description 1:*
"Researchers evaluated a parent support program for young mothers (40 pregnant and parenting culturally diverse females ages 14 to 21 years) in two diverse counties in the mid-South. The young mothers who chose to participate in the parent support groups were given a survey at the end of the 6-week program. The survey data showed that nurturing parenting behaviors, including appropriate discipline and communication techniques, celebrating special events, and reading books to their children, were reported by the more of these young mothers than by other young mothers who were from the same counties but who were not in the program."

1. If a media article was being written on this research, what would be an accurate title? Please craft an accurate, short media headline that references the two variables of interest (i.e., parent support group participation & parenting behaviors) and the relationship between them.

   _____

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2. We've also developed a few media headlines based on this research. Which of the following is an appropriate headline for this research? (Check all that apply)

   ☐ Parent support group participation promotes nurturing parenting behaviors
   ☐ Parent support group participation can promote nurturing parenting behaviors
   ☐ Parent support group participation is associated with nurturing parenting behaviors
   ☐ Parent support group participation may be associated with nurturing parenting behaviors

*Research Description 2:*
"Researchers conducted a cross-sectional study of college students' academic motivations and reports of helicopter parenting. In the study, 192 college students reported their academic motivations and their perceptions of their mothers' helicopter parenting behaviors. The survey data showed that students who reported more helicopter parenting by their mother had more maladaptive academic motivations, including extrinsic motivation to learn, perfectionistic tendencies, and avoidance goals for learning, than did students who reported less helicopter parenting by their mother."

1. If a media article was being written on this research, what would be an accurate title? Please craft an accurate, short media headline that references the two variables of interest (i.e., helicopter parenting & academic motivations) and the relationship between them.

   _____

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2. We've also developed a few media headlines based on this research. Which of the following is an appropriate headline for this research? (Check all that apply)

   ☐ Helicopter parenting causes maladaptive academic motivations
   ☐ Helicopter parenting can cause maladaptive academic motivations
   ☐ Helicopter parenting is associated with maladaptive academic motivations
   ☐ Helicopter parenting may be associated with maladaptive academic motivations

## Appendix B: Parenting Opinion Questions

**Please respond to the following questions. There are no correct answers to the questions, so please respond in a way that most accurately represents your true beliefs.**

1. I believe that participating in parent support groups is a positive parenting behavior.

| Strongly Disagree | Disagree | Neither Disagree nor Agree | Agree | Strongly Agree |
|---|---|---|---|---|
| ☐ | ☐ | ☐ | ☐ | ☐ |

2. I believe that helicopter parenting is a positive parenting behavior.

| Strongly Disagree | Disagree | Neither Disagree nor Agree | Agree | Strongly Agree |
|---|---|---|---|---|
| ☐ | ☐ | ☐ | ☐ | ☐ |

## Appendix C: Demographic Questions

1. I identify as:
   - o Male
   - o Female
   - o Other _____

2. Choose one or more races that you consider yourself to be:
   - o White
   - o Black or African American
   - o American Indian or Alaska Native
   - o Asian
   - o Native Hawaiian or Pacific Islander
   - o Other _____

3. What is your age? _____

4. What is the highest level of education you have completed?
   - o Less than a high school diploma
   - o High school degree or equivalent (e.g. GED)
   - o Some college, no degree
   - o Associate degree (e.g. AA, AS)
   - o Bachelor's degree (e.g. BA, BS)
   - o Master's degree (e.g. MA, MS, MEd)
   - o Professional degree (e.g. MD, DDS, DVM)
   - o Doctorate (e.g. PhD, EdD)

5. How many years have you been a teacher for? _____

6. What subject area do you teach? _____

7. During a typical week, what percentage of time at work do you spend:
   Teaching _____
   Researching _____
   Advising _____
   Other _____

8. What type of institution do you work for?
   - o Elementary school (ages 5-11)
   - o Middle school (ages 11-14)
   - o High school (ages 14-18)
   - o Tribal College
   - o Special Focus Institution (e.g., Faith-Related Institutions)
   - o Two-year Associate’s College
   - o Four-year Baccalaureate College

- o Master's University
- o Doctoral University (R1 & R2)
- o Other _____

## Appendix D: Cover Story Success Check

1. What do you think is the primary objective of this research?