Exploring Factors that Influence Judgements of Climate Change Statements

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Abstract

This aim of the current study was to examine the effect of repetition (i.e., illusory truth effect) and non-probative photographs (i.e., truthiness effect) on mean truth ratings of climate change statements using a within-subjects design. A total of 80 participants were asked to provide truth ratings to climate change statements in two parts. At Time 1, half of the statements appeared with photographs and half without photographs, while at Time 2, repeated statements from the first part were intermingled with a set of new statements. None of the statements at Time 2 appeared with photographs. It was hypothesized that statements paired with photographs and repeated statements would receive higher truth ratings than statements not paired with photographs and new statements. Likewise, it was predicted that repeated statements that had been paired with photographs at Time 1 would receive higher truth ratings compared to repeated statements that were not paired with photographs. Three planned comparisons and a paired samples *t*-test were used to assess the effect of repetition and photographs on truth ratings. The only significant difference in truth ratings observed was between repeated and new statements, with repeated statements receiving higher mean truth ratings than new statements. No influence of photographs or a cumulative effect of both repetition and photographs was found. Exploratory analyses of the effect of the type of statement (true or false) on truth ratings showed that, true statements were perceived as truer, and false statements were perceived as less true when paired with photographs (as compared to when not paired with photographs). Implications of findings, limitations of the current study and future research are also discussed.

Keywords: fluency, truthiness, illusory truth effect

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This project was evaluated and approved by the Massey University Human Ethics Committee: Southern B (refer to Appendix A for approval letter).

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Chapter One

Introduction

A statement should ideally not be accepted as true in the absence of factual evidence for a claim (Begg, Anas, & Farinacci, 1992; Dechêne, Stahl, Hansen, & Wänke, 2010). While people frequently rely on their memories to examine if the presented information is consistent with existing facts, this does not always happen (Begg et al., 1992). Instead, individuals may rely on heuristic cues or intuitive hunches when making judgements (Begg et al., 1992; Dechêne et al., 2010; Newman, Garry, Bernstein, Kantner, & Lindsay, 2012). Heuristics can be defined as mental shortcuts that help reduce complex tasks and simplify mental processes to aid judgement or decision making (Mangus, 2018; Tversky & Kahneman, 1974). For example, when presented with ambiguous claims such as "Osorno is in Chile" (Reber & Schwarz, 1999, p. 339), people may rely on heuristic cues to guide their judgement making process (Dechêne et al., 2010; Tversky & Kahneman, 1973). These heuristic cues may utilize various attributes such as the level of expertise or credibility of a claim's source, attributes of the context in which it is encountered (e.g., scientific conference), or attributes of the claim (e.g., high or low contrast of fonts) to draw conclusions of a claim's veracity (Dechêne et al., 2010; Newman et al., 2012). Understanding how people use heuristic cues to make judgements is important as it influences their behavior in relation to the claims and information (e.g., marketing claims) that they encounter (Roggeveen & Johar, 2002; Hawkins & Hoch, 1992).

The illusory truth effect and the truthiness effect are two phenomena that occur as a result of the use of heuristic cues when judging the veracity of statements (e.g., Dechêne et al., 2010; Newman et al., 2015). Despite the similarity in underlying mechanisms, these two effects have been examined separately. Furthermore, the majority of research in these two

areas have focused on the use of trivia or general knowledge statements (e.g., Hasher, Goldstein, & Toppino, 1977; Newman et al., 2012) as the ambiguity inherent in these statements minimizes the reliance on pre-existing knowledge in the memory (Arkes, Hackett, & Boehm, 1989; Fazio, Brashier, Payne, & Marsh, 2015). However, it is commonplace for individuals to encounter statements or information for which they have some existing knowledge or opinions (Amelung, Fischer, Kruse, & Sauerborn, 2016; Cook, 2017; Pennycook, Cannon, & Rand, 2018). Thus, this study examines how the use of repetition in the illusory truth effect and the pairing of photographs in the truthiness effect cumulatively exert their effects on the truth judgements of value and affect-laden claims such as climate change statements (e.g., Milfont, Wilson, & Sibley, 2017).

The current literature review aims to address some of the aforementioned gaps by examining existing literature on both the illusory truth effect and the truthiness effect. The first part expands on the illusory truth effect, its underlying mechanisms, and briefly addresses some of the moderators of this effect. The second part will cover studies on the truthiness effect as well as the mechanisms underlying this effect and the moderators. This will be followed by a section looking at climate change communication and the use of repetition and images in this domain. The final section will cover the aims of the study and the hypotheses put forth to achieve these aims.

Chapter Two

Literature Review

The Illusory Truth Effect

The illusory truth effect[1] also commonly known as the "truth effect" (Unkelbach, 2007) is a memory phenomenon that occurs due to repetition, such that repeated statements are judged as more true than new statements (Arkes, Boehm, & Xu, 1991; Arkes et al., 1989; Bacon, 1979; Begg et al., 1992; Begg, Armour, & Kerr, 1985; Dechêne et al., 2010; Fazio et al., 2015; Gigerenzer, 1984; Hasher et al., 1977; Schwartz, 1982; Silva, Garcia-Marques, & Reber, 2017; Unkelbach, 2007; Unkelbach & Rom, 2017). The use of repetition as a means of conveying information is not a novel one. Its use is evident in recent world events such as the Russiagate controversy, the phenomenon of 'fake news' as well as long-standing debates surrounding the link between vaccination and autism (Majin, 2019; Pennycook et al., 2018; White, 2014). Before delving deeper into examining the illusory truth effect, the importance of this effect in real world events will be illustrated through two examples.

Russiagate controversy and the vaccination-autism debate. The Russiagate controversy received extensive coverage between 2017 and March 2019 (Majin, 2019). Coverage on this phenomenon focused on the enquiry of whether the President of the United States had "colluded with Russia in order to win the 2016 election" (Majin, 2019, p. 2). The mainstream media not only took to reporting allegations that lacked confirmatory evidence but also repeated "accusations of Russian-Trump collusion" inter-mixed with real facts that

[1] It is also known as the "validity effect" (Arkes et al., 1991), the "repetition-validity effect" (Brown & Nix, 1996), the "frequency-validity effect" (Gigerenzer, 1984; Hasher et al., 1977), and the "repetition-induced truth effect" (Dechêne et al., 2010).

arose from the enquiry (Majin, 2019, p .4). According to the author, the term "Trump Russian Collusion" had resulted in "82,900 results in the news category and more than 1.4 million results on a web-wide search", bearing evidence to the degree to which this event was repeated over and over again across media platforms (Majin, 2019, p. 2). Despite the lack of solid evidence and the inconclusive nature of information being presented to the media audience, individuals were led into believing these allegations which were eventually proven to be untrue.

Likewise, repetition has also played a key role in the debate surrounding the vaccination-autism link (Hoffman et al., 2019). The vaccination-autism debate started with the findings from Wakefield et al. 's (1998) study which claimed an association between the measles, mumps, and rubella (MMR) immunization and autism. Several rigorously conducted studies have since found no support for Wakefield et al.'s (1998) conclusions. For instance, even when the decrease in the rate of exposure to the MMR vaccine was found not to correlate with concurrent decreases in the incidence of autism, individuals continued to believe in it (Davidson, 2017, p. 405; Gerber & Offit, 2009; Madsen et al., 2002; White, 2014). While Wakefield et al.'s (1998) paper has since been retracted, the repetition of erroneous evidence and celebrity testimonies have caused parents to err on the side of caution, with an increasing number of them opting out of MMR vaccines (Davidson, 2017; White, 2014). In both the aforementioned examples of the Russia gate phenomenon (Majin, 2019) and the vaccination-autism debate (e.g., White, 2014), there was unclear evidence regarding the veracity of the information made available to individuals. In spite of this, individuals were led to "trust the wisdom of the crowd" (Fazio et al., 2015, p. 1000) in accepting what is being repeated as true (even if momentarily) rather than attempting to effortfully process the information that is being presented to them.

Assessing the truth effect[2]. Experiments set up to illustrate the illusory truth effect usually involve a two-step process (e.g., Dechêne et al., 2010). In the first session, participants are usually asked to rate a series of statements for truth[3] or interestingness (e.g., Begg et al., 1992). This is then followed by a second session (or multiple sessions) where participants are presented with another set of statements. A number of these statements will be repetitions from the previous session and the others will be new statements (Dechêne et al., 2010). Participants will then, once again be asked to rate these statements for truth (Dechêne et al., 2010). In order to understand the illusory truth effect, it is crucial to know how this effect is assessed (Dechêne et al., 2010). This is done through the fulfilment of two criteria. The first criterion also known as the within-items criterion entails comparing the truth judgments[4] of statements presented during session one with those of the same set of repeated statements in session two (Hasher et al., 1977; Dechêne et al., 2010). The second criterion involves comparing the truth ratings of repeated statements with those of new statements (i.e., between-items criterion) (Dechêne et al., 2010; Hasher et al., 1977). Ideally, the increase in mean truth ratings across sessions and the higher truth ratings for repeated as compared with new statements indicates the presence of an illusory truth effect (Dechêne et al., 2010).

The illusory truth effect is a robust phenomenon that has been shown to occur irrespective of the different presentation times of statements (i.e., the time for which participants view a statement) (Gigerenzer, 1984). It has also been shown to occur across

[2] The term illusory truth effect and truth effect are used interchangeably in this review based on past studies.

[3] Truth, validity, credibility, and accuracy have often been used to indicate the same thing. All the terms refer to indicating how true or false one considers a statement to be.

[4] Truth judgements and truth ratings have been used interchangeably in past literature and will be used as such in this review.

different inter-session intervals between repetitions of statements including minutes (Arkes et al., 1989; Begg et al., 1992; Begg & Armour, 1991; Begg et al., 1985; Schwartz, 1982) and weeks (Bacon, 1979; Gigerenzer, 1984; Hasher et al., 1977). For instance, Gigerenzer (1984) asked participants to provide truth ratings for statements involving general topics (e.g., history, sports, physical science) on three separate occasions separated by either a one-week or two-week interval. Irrespective of the length of interval between sessions, a truth effect was found (Gigerenzer, 1984). Schwartz (1982) on the other hand, attempted to test whether the illusory truth effect would still occur if repetitions were spaced only minutes apart. The premise for this was based on Bacon's (1979) recognition explanation (covered below) for the truth effect. According to this explanation, the recognition[5] of a statement as being repeated (or not) is a crucial factor in influencing truth ratings. Hence, shorter intervals should allow for easier recognition of a statement as being repeated, which would in turn result in higher truth ratings (Schwartz, 1982). In line with this, repeated statements in Schwartz's (1982) study were rated significantly truer than those that were not, thus, providing some support for the recognition explanation. Having had a brief look at how the truth effect is assessed and its implications in the real world, the discussion turns to possible mechanisms underlying the truth effect.

Mechanisms Underlying the Illusory Truth Effect

Several explanations including memory for repeated facts, frequency of repetition, recognition, familiarity, processing fluency, and source recollection have been put forth to account for the illusory truth effect.

The memorial account. Begg and Armour (1991) suggested that the differences in truth ratings between repeated and new statements reflects the extent to which the tested statements match the facts retrieved during the initial processing of these statements in the

[5] Recognition refers to the explicit identification of whether a statement is repeated or new.

learning phase (Begg & Armour, 1991). According to this explanation, when an individual first encounters a statement, it creates a memory trace (Whittlesea & Williams, 2000). Subsequently, when a later statement expressing either some or all of the facts is presented, there is an increased likelihood that this statement (as opposed to a new one) will activate the trace (Begg & Armour, 1991; Whittlesea & Williams, 2000). This congruence between the presented and retrieved facts then, provides a heuristic basis for the "ring of truth" (Begg & Armour, 1991, p. 197), such that statements that affirm remembered information are rated as most credible and those that contradict this information are rated the least credible (Bacon, 1979; Begg et al., 1985). Support for this was demonstrated by Begg et al. (1985) who found that prior exposure to the topic of the statement made a statement appear truer than in the case for statements of new topics as the former is more likely to retrieve facts from the memory.

To test this proposition, participants were presented with a set of topics such as "hen's body temperature" or the "Statue of Liberty" and were later asked to rate the truth of statements such as "The temperature of a hen's body is about 104 degrees Fahrenheit" (Begg et al., 1985, p. 202). Participants were randomly assigned to three groups: one group studied a list of topics (i.e., the topic repetition condition), one group studied entire statements (i.e., statement repetition condition), and the last group was neither exposed to the statements nor topics (i.e., control condition) (Begg et al., 1985). They then proceeded to rate statements for probable truth (half of the statements were based on repeated topics and half were based on new topics) at a later session (Begg et al., 1985). While there was no difference in truth ratings between statements for the control condition, in the statement repetition condition repeated statements were rated as truer than new statements (Begg et al., 1985). Likewise, in the topic repetition condition, statements based on repeated topics were rated truer than statements based on new topics (Begg et al., 1985).

Frequency explanation. Hasher et al. (1977) on the other hand, noted that while individuals could judge the validity of ambiguous statements such as "The population of Greenland is about 50,000" (p. 107) by assessing their semantic memory, they were still willing to determine the truth or falsity of statements for which they possessed no information. One way in which they gauged the truth status of a statement was through the frequency with which they encountered it (Hasher et al., 1977). Frequency helps one distinguish between old and new events (Hasher et al., 1977; Underwood, Zimmerman, & Freund, 1971). Furthermore, frequency acts as a marker of plausibility, the more often one hears that "50,000 people live in Greenland", the more certain one will come to believe that it is true (Hasher et al., 1977, p. 108). The authors thus, suggested that as a repeated statement increases in frequency, its perceived truth also increases. In order to test this, Hasher et al. (1977) had subjects rate trivia statements on a range of topics including sports, geography, and the arts such as "Australia is approximately equal in area to the Continental United States" (p. 109). Some of these statements were repeated while others were not. Statements were rated for validity over three sessions, each separated by a two-week interval. Subjects rated repeated statements (i.e., statements that were heard twice) as more true than non-repeated statements (i.e., statements that were heard once), leading to the conclusion that the frequency of repetition enhances one's belief in the truth of a statement. This explanation however, was challenged by Bacon (1979).

Recognition explanation. Bacon (1979) proposed that it was not the actual repetition status (i.e., the actual frequency that a statement is presented) but the perceived repetition (i.e., the recognition of whether a statement is repeated or new) that was the key determinant of rated validity. Although both Bacon's (1979) recognition explanation and Hasher et al.'s (1977) frequency explanation are able to account for the truth effect, they both lead to different expectations. According to the frequency account, truth ratings should be more

sensitive to an item's *actual* status of being repeated or new (Hasher et al., 1977). In contrast, if truth ratings were inferred from recognition, then *judged* rather than the actual repetition status of a statement should be associated with an increased belief in a statement's truth (Arkes et al., 1989; Bacon, 1979). In the latter case, repeated statements should be rated credible to the extent that the repetition is detected. Bacon (1979) found support for the recognition explanation. Statements judged to be repeated (as opposed to new) were also judged to be relatively true; this was independent of whether the recognition decision was correct (i.e., whether the statements were actually repeated or not) (Bacon, 1979). Interestingly, in contrast to Hasher et al.'s (1977) explanation, statements that were *actually* repeated or new only differed marginally from each other. Given this, recognition rather than frequency was concluded to be central to the illusory truth effect (Arkes et al., 1991; Bacon, 1979). Thus, while *actually* repeated statements are more likely to feel familiar than new statements (which increases the likelihood of these statements being rated as more valid) statements that are familiar enough to be *recognized* as a repetition are also more likely to receive higher validity ratings (Arkes et al., 1991; Bacon, 1979).

It is important to note that some studies have used the terms recognition and familiarity interchangeably (e.g., Hawkins & Hoch, 1992). However, the familiarity explanation is regarded as a more general account compared to the recognition explanation (Arkes et al., 1991; Roggeveen & Johar, 2002). The familiarity explanation suggests that the use of repetition increases the familiarity with a statement's semantic content (i.e., general topic of a statement) which in turn informs truth judgements; it occurs irrespective of whether one is able to recognize the repetition (Roggeveen & Johar, 2002). The recognition explanation necessitates an explicit recognition judgement prior to assessing validity (Bacon, 1979).

Processing fluency. More recently, the term processing fluency has been used to account for the truth effect (Dechêne et al., 2010). According to Dechêne et al. (2010), recognition and processing fluency are essentially two sides of the same coin. Recognition, while crucial to the truth effect is an explicit memory process. Given that the truth effect can still be observed in the absence of this explicit recognition, an implicit memory process is thought to account for this part of the truth effect (Dechêne et al., 2010). Processing fluency, then refers to this "nonreferential, implicit part of the truth effect" (Dechêne et al., 2010, p. 239). Processing fluency can be defined as the "metacognitive experience of ease during information processing" (Alter & Oppenheimer, 2009; Dechêne et al., 2010, p. 240). This ease in processing is in turn misattributed to the truth of the statement, resulting in the truth effect (Unkelbach, 2007).

Given the different explanations used to account for the illusory truth effect, the terms familiarity, recognition, and processing fluency are summarized as follows for clarity. The effect of repetition on the truth ratings of statements is mediated by familiarity (covered below), which is the feeling that something has been encountered previously without explicitly recollecting the event(s) (Arkes et al., 1989; Unkelbach, Koch, Silva, & Garcia-Marques, 2019). Recognition, is an explicit process of recognising something (i.e., an item, statement) when re-encountered. It is often used as a proxy measure for familiarity. The ease of processing that occurs as a result of repetition and drives the illusory truth effect is termed processing fluency.

Familiarity as a mediator. The use of repetition in studies examining the truth effect helps to increase familiarity and boost processing fluency (Unkelbach, 2007). The discussion of familiarity is an important one as it has been shown to mediate the illusory truth effect. Participants in Roggeveen and Johar's (2002) study were provided with fake consumer testimonials about various Australian products, with each claim associated with either one or

two names at each exposure; some of these claims were repeated whereas the others were new. Participants were asked to provide truth ratings during the first session and ratings of truth and recognition (i.e., whether they remembered seeing the claim previously) at session two. Recognition in this study was used as a measure of subjective familiarity. In addition to replicating the truth effect (i.e., repeated claims were rated more credible than new claims), evidence for the mediating role of familiarity was also found. This was illustrated through a three-step process by the authors: 1) a significant effect was found when truth ratings were regressed on a Repetition[6] factor; 2) a significant effect was found when truth ratings were regressed on recognition; 3) the inclusion of both repetition and recognition in the model resulted in the effect of repetition becoming insignificant, thereby, showing that recognition which was used as a proxy for familiarity mediated the truth effect. This observation was also made by Hawkins and Hoch (1992) who, in testing for mediating relations between repetition, recognition, and truth ratings for consumer trivia claims, found that the addition of recognition in the statistical model eliminated the positive effect of repetition on truth judgements.

Source recollection, credibility, and dissociation. In addition to the aforementioned factors, source recollection, credibility, and dissociation have also been used to explain the truth effect. Recollection of a source and its credibility involves the controlled use of memory and is intentional (Begg et al., 1992). When asked to evaluate the veracity of a statement, participants often attempt to identify the source of the statement (e.g., Where have I previously heard this statement?) (Brown & Nix, 1996). Depending on the credibility of the source, the rated truth of the statement is modified accordingly (Begg et al., 1992). Relatedly, source dissociation or variability has also been suggested as a determinant of rated validity

[6] Repetition refers to the repeated or new status of statements.

(Arkes et al., 1991; Arkes et al.,1989; Roggeveen & Johar, 2002). Repeated statements are likely to be viewed as more valid if they are perceived to be from different sources. The perception of the same information coming from a variety of sources implies convergent validity (Arkes et al., 1991). For example, Arkes et al. (1991) presented a set of trivia statements paired with either high familiarity or low familiarity names and asked participants to rate their validity, familiarity (i.e., whether they have seen the item before or not) and source (i.e., where they might have seen the statements before- first time seeing the item, friends, newspaper etc.). This was followed up by a second session either one, three, or five weeks later where they were asked to rate new and repeated statements for validity, familiarity, and source of prior occurrence (one option included 'the first session of the experiment') (Arkes et al., 1991). Results found an association between source dissociation at session one and rated validity at session two; statements attributed to sources outside the experiment in the first session tended to be rated higher in terms of validity in the second session (Arkes et al., 1991). While source dissociation is not necessary for the illusory truth effect, it has been shown to enhance the effect if present (Arkes et al., 1989; Roggeveen & Johar, 2002).

Source recollection and familiarity as separate pathways. While both source recollection and familiarity are implicated in the truth effect, these two processes have been shown to have independent influences on truth ratings (e.g., Brown & Nix, 1996; Silva et al., 2017). Source recollection involves the controlled use of memory whereas familiarity is regarded as an automatic consequence of exposure, with its influence on rated truth being unintentional (Begg et al., 1992; Dechêne et al., 2010). In order to understand the independent roles of both mechanisms, studies tend to "tag" statements as true or false via honest and dishonest sources at presentation (Begg et al., 1992; Brown & Nix, 1996) or use contradictory statements (e.g., Garcia-Marques, Silva, Reber, & Unkelbach, 2015).

Tagging statements as "true" or "false". For instance, Begg et al. (1992) paired statements with either male or female names that were known or unknown (e.g., "*John Yates* says that 300,000 pencils can be made from the average cedar tree") and told participants to study these statements. They were then told that statements paired with unknown names were *true* and those paired with known names were *false* (or vice versa) or that the statements by males were *true* and those by females were *false* (or vice versa) (Begg et al., 1992). Following this, participants were presented with repeated and new statements and tested for truth without the sources (Begg et al., 1992). If both source recollection and familiarity were independent, they would have different effects on the truth ratings of statements, particularly for *false* statements. *True* repeated statements would be rated true irrespective of source recollection or familiarity. In contrast, *false* repeated statements would be rated truer than new statements when the influence of familiarity exceeds the influence of recollection whereas, they would be rated falser than new statements if the influence of recollection is stronger (Begg et al., 1992). Begg et al. (1992) found statements paired with *true* sources to be rated truer than statements paired with *false* sources which were in turn rated truer than new statements (Begg et al., 1992). The influence of recollection however, was found to be stronger when statements were paired with known names as opposed to unknown names (Begg et al., 1992).

Using contradictory statements. On the other hand, participants in Garcia-Marques et al.'s (2015) study were exposed to a particular set of trivia statements at the first instance but were asked to make truth judgements of statements that were similar perceptually but contradicted the earlier statement later on (e.g., original statement: "The first animated film was shot in *France*"; contradictory statement: "The first animated film was shot in *England*"). The truth ratings were done either within the same session or one-week later. Half the participants were asked to provide truth ratings for the original statements together with

new statements, the other half provided ratings for contradictory statements together with new statements. While statements that were repeated verbatim were rated truer than new statements across both time intervals, the difference in truth ratings for contradictory statements depended on the length of the time interval. Within the same session, contradictory statements were found to be rated as more false compared to new statements. One week later, these same statements were judged truer than new statements. Given that the ratings done within the same session facilitate source recollection due to the short interval, contradictory statements were rated falser than new statements. The opposite effect was observed for the long delay because of the lower likelihood of recollecting the original statement. Thus, despite the lower tendency to recall the details of the original statement after a long delay, the similarity in topic with the original statements resulted in contradictory statements feeling more familiar than new statements (Garcia-Marques et al., 2015). As mentioned previously in the memorial explanation by Begg and Armour (1991), truth ratings of statements have not only been shown to increase when repeated verbatim but also when the topic is repeated (as with contradictory statements in this study) (also see Arkes et al., 1991; Bacon, 1979; Begg et al., 1985).

Having looked at some of the explanations for the illusory truth effect and the mechanisms underlying it, the following section explores some of the proposed moderators of the effect of repetition on truth judgements.

Moderators of the Illusory Truth Effect

Some of the factors found to moderate the truth effect include the type of processing task, (Hawkins & Hoch, 1992), the judgement context (Dechêne, Stahl, Hansen, & Wänke, 2009, 2010), cognitive load (Mangus, 2018), and pre-existing knowledge. Of these, judgement context and the effect of pre-existing knowledge will be focused on given their direct relevance to the current study.

Judgement context. As mentioned previously, familiarity that results from repetition increases processing fluency which is in turn used as a heuristic cue for truth. However, it has been argued that it is the difference in fluency between currently processed items rather than the absolute level of fluency that influences truth judgements (i.e., discrepancy-attribution hypothesis) (Dechêne et al., 2009, 2010; Hansen & Wänke, 2008; Whittlesea & Williams, 1998, 2000). According to the discrepancy-attribution hypothesis, this difference in fluency occurs when a certain experience is compared against a standard. This standard can be either a preconceived expectation that is held in the mind or the average processing fluency of other stimuli within the same context (Dechêne et al., 2009, 2010; Hansen & Wänke, 2008; Whittlesea & Williams, 1998, 2000). In order to illustrate this Whittlesea and Williams (1998) created three pools of stimuli: Common natural words (e.g., RAINBOW, CANDLE), orthographically regular non-words (e.g., HANSEN, BARDEN), and orthographically irregular non-words (e.g., JUFICT, STOFWUS). Participants were then exposed to each of these three types of words and asked to memorize them for a later recognition test. Subsequently, they were shown repeated and new items of each type of word and asked to perform three tasks: pronounce the word, decide if it was a word or non-word, and decide if it had been presented earlier. The percentage of false alarms for the words was used as a measure of familiarity (i.e., indicating that a word or non-word has been presented earlier when it was not). Overall, regular non-words produced the most false alarms, followed by natural words, with the least number of false alarms for irregular non-words (Whittlesea & Williams, 1998). According to the discrepancy-attribution hypothesis, feelings of familiarity are produced when the actual processing fluency of an item is different from one's expectation of its fluency (Whittlesea & Williams, 1998). In line with this, the ability to name natural words quickly is consistent with the expectation that these are well-known words (Whittlesea & Williams, 1998). Similarly, the lower fluency encountered with irregular non-

words is consistent with the expectation that these are not actual words (Whittlesea & Williams, 1998). This is not the case for regular non-words; the fluent processing (because of their similarity to natural words in terms of ease of pronunciation-BARDEN vs. GARDEN) is different from the expectation that non-words would be named slower given that they are not actual words (Whittlesea & Williams, 1998). This discrepancy in fluency is then unconsciously attributed to another plausible source such as a previous experience or presentation resulting in a false sense of familiarity (Whittlesea & Williams, 1998).

In the above example, the processing fluency of common natural words was used as a comparison standard. This comparison standard however, varies depending on the contexts where different standards are used in evaluating the processing fluency (Whittlesea & Williams, 2000). Within the context of repetition, Dechêne et al. (2010) looked at how a heterogenous and a homogenous context might influence the illusory truth effect. A mixture of repeated and non-repeated statements is used in a heterogenous context. Within this context, participants may notice that some statements (i.e., repeated statements) are more fluently processed than the others, which may then be used as a heuristic cue to inform their judgements. Unlike the heterogeneous context, there is little variability in processing fluency within a homogenous context where the same set of statements are used at both instances. In this case, differences in fluency are less likely to be used as a cue for truth; instead statements' average fluency can be used as a standard against which other statements are compared (Dechêne et al., 2010). In order to illustrate the effect of contexts on truth ratings, Dechêne et al. (2009) manipulated the type of statements between participants; one group of participants were required to rate trivia statements that were a mix of repeated and new statements (mixed-list), one group rated only repeated statements, and the last group rated all new statements. A large truth effect was found in the mixed list condition (i.e., heterogenous context) but not in the condition where only repeated statements were presented (i.e.,

homogenous context). Repeated statements in the mixed-list condition were not only rated truer in session two than in session one but were also rated truer than the new statements. These findings suggest that increased fluency due to repetition alone may not be sufficient to produce the truth effect (Dechêne et al., 2009). Rather, the experience of different levels of fluency, which mixed lists afford, is necessary to elicit the truth effect (Dechêne et al., 2009). This result has been replicated by several studies examining the truth effect given that most study designs utilize a heterogenous list of statements (e.g., Bacon, 1979).

Schwartz (1982) however, found the opposite. In this study, participants were placed in one of the two groups in which they either rated the same set of statements over two sessions or they rated a mix of repeated statements from the first session together with new statements (Experiment 2). Surprisingly, the truth effect was found in both groups regardless of whether participants rated the same statements or a mix of repeated and new statements; an increase in mean truth ratings was found from the first to the second session. This in turn led the author to conclude that a mixed-list or a heterogenous context might not be necessary for the truth effect. However, given the small effect size found in Schwartz's (1982) study, this finding should be interpreted with caution. It is also important to note that in Dechêne et al.'s (2009) study, sessions were spaced one-week apart while in Schwartz's (1982) study, truth ratings were provided within the same session. Thus, results across these two studies may not be entirely comparable.

Pre-existing knowledge. Prior work assumes that people only rely on fluency if knowledge retrieval is unsuccessful. This is the primary reason for using difficult trivia statements in illusory truth effect studies (e.g., Bacon, 1979; Gigerenzer, 1984; Hasher et al., 1977) for which individuals have limited (or no) knowledge of the statements and are thus more likely to be influenced by factors such as repetition (Arkes et al., 1989; Parks & Toth, 2006; Srull, 1983). In order to examine the effect of knowledge on truth judgements, Arkes et

al. (1989) showed participants a set of opinion and trivia statements from seven categories: food, literature, science, art, history, entertainment, and sports. They were then instructed to use a '1' to indicate the topic about which they knew the most, '2' the next most, and so on for the seven categories. The two topics a subject ranked as the ones they were the most knowledgeable about were collapsed into one category (i.e., the high expertise category), the two topics each subject ranked as the ones they were least knowledgeable about into one category (i.e., the low expertise category), and the middle three topics comprised the medium expertise category. Results indicated that the influence of repetition on rated validity was restricted to those topics about which subjects were highly or moderately knowledgeable but not the ones that they were least knowledgeable about. In other words, a stronger truth effect was found for statements for which participants had greater knowledge than those for which they had less knowledge about. These findings were attributed to the fact that individuals knowledgeable about a topic may remember material in that topic domain better than do those who are less knowledgeable (Arkes et al., 1989). Given that recognition is considered important for the truth effect, the higher tendency to recognize and remember statements from the earlier session among those with greater knowledge of a topic domain may result in these statements being rated as more valid (compared to those who do not know much about the topic domain) (Arkes et al., 1989; also see Parks & Toth, 2006; Srull, 1983).

Fazio et al. (2015) on the other hand, conducted a 2 (Repetition: repeated, new) by 2 (Estimated knowledge: known, unknown) within-subjects study in which opposite results were found. Participants' knowledge in this study did not interact with repetition to influence truth ratings suggesting that people retrieve their knowledge only when fluency is absent (i.e., if a statement is new, or was not attended to during the exposure phase, or if the participant spontaneously discounts fluency while reading repeated statements) (Fazio et al., 2015). To support this conclusion Fazio and colleagues tested the fit of two models: the knowledge-

conditional model and the fluency-conditional model. The knowledge-conditional model assumes that when judging a statement's truth, people search their memory for relevant evidence. If this search succeeds, all other processes are irrelevant, and the participant answers correctly. If the search fails, due to a lack of knowledge or insufficient cues, the participant may rely on fluency to make the judgment (Fazio et al., 2015). The fluency-conditional model on the other hand, assumes that fluency can supersede the retrieval of knowledge. In this case, the participant only searches memory if fluency is absent or discounted. The knowledge-conditional model demonstrated poor fit whereas the fluency-conditional model offered a better fit, demonstrating that fluency can influence people's judgments even in contexts that allow them to draw upon their stored knowledge (Fazio et al., 2015).

The evidence regarding the impact of pre-existing knowledge on truth ratings thus appears to be mixed. Given the inconclusive evidence, it will be of interest to explore if the effect of repetition on truth ratings is replicated when climate change statements are used in place of trivia statements given that participants will most likely possess some knowledge about this topic. The following section examines the truthiness effect, a memory phenomenon similar to the illusory truth effect.

The Truthiness Effect

Unlike the illusory truth effect, the topic of truthiness is a relatively recent area of research (Mangus, 2018). The term "truthiness" was coined by Stephen Colbert to refer to subjective feelings of truth (Newman et al., 2012, p. 969). Similar to the use of repetition to influence truth judgements (e.g., Hasher et al., 1977), the pairing of non-probative information with a claim has been shown to bias individuals towards believing the claim (Fenn, Newman, Pezdek, & Garry, 2013; Mangus, 2018; Newman et al., 2012; Newman et al., 2015). Non-probative information, in this case, refers to any information that is related to

the claim but does not provide any evidence regarding its truth (Newman et al., 2012; Newman et al., 2015). Within the literature on the truthiness effect, the pairing of non-probative photographs with statements has received the most attention. Photographs are not only believed to be credible but they are also believed to help increase the ease of bringing forth related images and thoughts regarding a claim (McCabe & Castel, 2008; Newman et al., 2012). This feeling of ease of accessibility of information, is then interpreted as evidence for truth (Alter & Oppenheimer, 2009; Cardwell, Henkel, Garry, Newman, & Foster, 2016; Fenn et al., 2013; Newman et al., 2012). For instance, Newman et al. (2012) found that in getting participants to provide binary truth ratings (true or false) to claims that a famous person (both familiar and unfamiliar) is dead or alive, the subjective truth ratings for both the "alive" and "dead" claims were inflated in the presence of photographs (Experiments 1A and 1B). This finding was also replicated when a different set of stimuli such as trivia statements were used (e.g., "Macadamia nuts are in the same evolutionary family as peaches") (Newman et al., 2012, p. 973, Experiment 3). Participants rated trivia statements that were paired with non-probative photographs as true more often than when they were not paired with photographs. In both these experiments, the truthiness effect was found to be more pronounced when the claims were either ambiguous or difficult (i.e., unfamiliar names, difficult trivia statements) (Newman et al., 2012; also see Cardwell et al., 2016).

Given that studies examining the truthiness effect usually involve a single session in which participants provide truth ratings to claims paired with and without photographs (e.g., Newman et al., 2012), not many studies have explored the persistence of the effect over time. One such study that examined the persistence of the truthiness effect was conducted by Fenn et al. (2013) who initially asked participants to provide truth ratings for a series of trivia claims (e.g., "Starfish do not have brains"); half of these claims were paired with non-probative photographs while the other half were not (p. 210). Approximately 48 hours later,

participants were invited again to provide truth judgements to the same set of statements seen in the previous session; the only difference being that none of the claims appeared with any photographs. Results yielded some support for the truthiness effect persisting over time, with the magnitude of the effect of photographs on truth ratings found to be consistent over time (Fenn et al., 2013).

Though photographs are inherently credible, it is important to understand the mechanisms through which these stimuli exert their influence on truth judgements. The next section of the review elaborates on some of the underlying mechanisms of the truthiness effect.

Mechanisms Underlying the Truthiness effect

Fluency and to a lesser extent, confirmation bias are two of the mechanisms argued to drive the truthiness effect.

Fluency. Fluency as previously defined in the section on the illusory truth effect refers to the subjective ease of mental processes that in turn affects judgements and decisions (Alter & Oppenheimer, 2009; Unkelbach et al., 2019). Photographs provide a rich semantic context which helps to bring to mind relevant thoughts and images that aid fluent processing (Newman et al., 2012; Newman et al., 2015). Upon being presented with the statement "Stephen King is alive" paired with a non-probative photograph of him, individuals may try to generate information about whether they have recently heard about him or seen advertisements for his latest book (Newman et al., 2012, p. 969). The ease with which they are able to generate information or thoughts[7] about the claim that he is alive is then unconsciously assumed to be relevant to the task at hand, which in turn produces illusions of

[7] Also known as the availability heuristic (Tversky & Kahneman, 1973). The heuristic relates to the use of this accessibility of information to make judgements.

truth (Newman et al., 2012; Newman et al., 2015; Tversky & Kahneman, 1973). This is because the ease with which one is able to generate information is used as an estimate for the frequency or probability of an event (Tversky & Kahneman, 1973). Hence, the easier it is for one to bring to mind information that "Stephen King is alive", the higher the tendency that one is likely to confirm that he is alive. For example, Schwarz et al. (1991) asked participants to recall either six or 12 examples of assertive or unassertive behaviours in which they had engaged. In this study, recalling six examples was deemed an easier task than recalling 12 examples. Those who were able to describe six instances of their assertive behaviour were more likely to consider themselves as more assertive than those who had to recall 12 instances of behaviours. Thus, the ease of recall experienced by participants in recalling these behaviours had an effect on how assertive or not they believed they were (Schwarz et al., 1991). In a similar way, statements that are paired with photographs may have an increased tendency of being rated true given that these photographs might help to bolster the likelihood of bringing forth related evidence or images which aid fluent processing as opposed to when the statements are not paired with photographs (Schwarz et al., 1991).

Confirmation bias. Nickerson (1998) defines confirmation bias as "the seeking or interpreting of evidence in ways that are partial to existing beliefs, expectations, or a hypothesis in hand" (p. 175). In simpler terms, it refers to a search for information that supports one's beliefs. One way in which non-probative photographs result in the truthiness effect is through scanning the details in these photographs or "trawling" through them to search for evidence for the particular claim. The statement "The liquid inside the thermometer is magnesium" paired with a photograph of a thermometer might lead individuals to engage in the following thought processes: "I can see a liquid metal inside, and I think magnesium is a metal" (Newman et al., 2015, p. 1338). The notion that individuals

tend to initially accept a statement as true can be linked back to Baruch Spinoza's[8] idea that understanding a claim entails implicitly accepting it as true (Gilbert, 1991). According to this line of reasoning, individuals may interpret the information they find through scanning a photograph as evidence for a default bias to view a claim as true (Gilbert, 1991; Newman et al., 2015; Nickerson, 1998).

The effect of photographs on truth ratings while driven by the mechanisms of fluency and confirmation bias are likely moderated by several factors. The next section focuses on judgement context and pre-existing knowledge as potential moderators of the truthiness effect.

Moderators of the Truthiness Effect

Judgement context. Similar to the illusory truth effect, the discrepancy between the expected and actual processing fluency is thought to give rise to the truthiness effect (Newman et al., 2015; Whittlesea & Williams, 2000).

In a series of experiments, Newman et al. (2015) examined if the effect of photographs on truth judgements was dependent on having a comparison standard (e.g., Dechêne et al., 2009, 2010). To test this, the presence of photographs was manipulated within-subjects. Participants were exposed to a set of trivia statements paired with either a related non-probative photograph (e.g., "The plastic things on the ends of shoelaces are called aglets" appeared with a photograph of a shoe with a shoelace), an unrelated photograph (e.g., the claim about shoelaces appeared with a photograph of a pig), or with no photograph

[8] Although Spinoza suggests that one has to accept a claim implicitly in order to understand it, they can still choose to not accept the belief or revise it at a later point. Disbelief is thus, not an impossibility but merely involves an additional step to undo the initial acceptance that is required for earlier comprehension (Gilbert, 1991).

(Newman et al., 2015, p. 1340). Taking the no photograph condition as a comparison standard, the presence of a related or unrelated photograph was expected to have a pronounced effect on truth ratings in a within-subjects design (Newman et al., 2015). In other words, a truthiness effect should result because related photographs should make claims relatively easier to process compared to claims not paired with photographs. Whereas, a falsiness effect should occur because claims paired with unrelated photographs should feel relatively more difficult to process compared to claims not paired with photographs. A falsiness effect refers to the tendency for statements paired with unrelated photographs to bias individuals toward disbelieving a claim (Newman et al., 2015). Newman and colleagues found that pairing claims with related photographs produced a truthiness effect where participants showed an increased bias to say true to these claims. Statements paired with unrelated photographs on the other hand, behaved more like statements paired with no photographs (Newman et al., 2015, Experiments 1-3). In the series of three experiments mentioned above, participants were shown eight practice statements with related photographs and eight practice statements with no photographs. Following this, they were shown 24 statements: eight were paired with related photographs, eight were paired with unrelated photographs, and eight appeared with no photographs. As such, participants saw trivia statements paired with related photographs 40% of the time, trivia statements with no photographs 40% of the time, and trivia statements with unrelated photographs 20% of the time. As such, the authors suggested that this could have caused participants to "oversee" the relationship between unrelated photographs and their associated statements (p. 1340). This in turn, resulted in the absence of a falsiness effect.

Given the unexpected finding of unrelated photographs failing to produce a falsiness effect, Newman et al. (2015, Experiments 5-6) manipulated the presence of photographs within-subjects and the relatedness of photographs (i.e., related or unrelated) between-

subjects. Doing so ensures that participants have minimal expectations about the association between photographs and claims. For one half of the participants, half of the claims appeared with a *related* photograph and half without a photograph while for the remaining participants, half of the claims appeared with an *unrelated* photograph and the other half without a photograph (Newman et al., 2015). Related photographs were found to produce a truthiness effect and unrelated photographs were found to produce a falsiness effect. To further confirm that a truthiness (and falsiness) effect was dependent on a standard, the authors conducted another experiment in which the photograph factor was manipulated entirely between-subjects such that one third of the participants saw claims paired with unrelated photographs, one third saw claims paired with related photographs and the remaining one third saw claims without photographs (Experiments 7-8). Both related and unrelated photographs did not produce the truthiness or falsiness effect respectively (Newman et al., 2015). These findings provided support for the discrepancy-attribution hypothesis (covered under the section: moderators of the illusory truth effect) (Whittlesea & Williams, 1998, 2000). When presented alone, claims paired with related photographs and claims paired with unrelated photographs do not produce a truthiness or falsiness effect as they meet the expectations for fluent and disfluent processing respectively. However, in the presence of a comparison standard (i.e., a no photograph comparison in this context), statements paired with related photographs likely feel more fluent and statements paired with unrelated photographs less fluent than if they were presented alone. This discrepancy in processing fluency is in turn used as a cue for truth ratings, leading to the truthiness (or falsiness) effect when a comparison standard is present (Whittlesea & Williams, 1998, 2000).

Pre-existing knowledge. Similar to the studies on the illusory truth effect, past studies on the truthiness effect have often used trivia or general knowledge questions. According to Abed, Fenn, and Pezdek (2017), the downside of using trivia claims is that

participants may already have an unspecified or unknown amount of related knowledge about these claims. For example, when presented with trivia claims such as “Turtles are deaf”, participants may already have some related information in their memory (e.g., turtles can swim) that may be primed upon seeing a photograph of a turtle (Abed et al., 2017, p. 204). This information primed by the photograph in turn facilitates processing and makes the statement feel somewhat familiar (Abed et al., 2017). Given this, Abed et al. (2017) sought to examine the role of background knowledge on truthiness through a series of experiments. The first experiment looked at the influence of personality-trait descriptive photographs on truth judgements about a hypothetical person (i.e., an individual for which participants do not have any pre-existing knowledge) and how this effect of photographs was moderated depending on the amount of information that was made available about the person (Abed et al., 2017). Participants were shown a set of personality traits (e.g., clumsy, perfectionistic) and were told to indicate whether they thought each trait was descriptive of a hypothetical person known as “Avery”. Participants were randomly assigned to either the low, medium, or high knowledge condition in which they were presented with the corresponding amount of information regarding Avery (i.e., little, moderate, or a lot of information). Half of the traits were paired with photographs whereas the other half was not. Mean truth ratings were higher when the personality traits were paired with photographs than when they were not; this difference was highly significant in the low-knowledge condition, small in the medium-knowledge condition and non-significant in the high-knowledge condition (Abed et al., 2017). In line with these findings, Abed and colleagues concluded that the impact of photographs on truth judgements is greater when there is lesser knowledge about a target stimulus.

The second experiment examined if photographs affected people’s judgements about personality traits and if it matters whether the person being judged is well-known (i.e., self,

best friend) or not (i.e., low knowledge “Avery” condition) (see previous paragraph for details) (Abed et al., 2017). In this case, the self and best friend would be individuals for whom the participants have the most background knowledge and the hypothetical person “Avery” would be someone for whom no related knowledge exists. The methodology was the same as in the first experiment (Abed et al., 2017). While the truth ratings for personality traits for the hypothetical person ”Avery” was significantly higher when it was paired with photographs than when it was not, there was no difference in truth ratings for the photograph and no photograph conditions for both the self and best friend. This was congruent with the earlier finding from the first experiment; photographs had a greater effect on truth judgements when there was limited knowledge about the target (Abed et al., 2017). According to the authors, when one possesses a lot of background knowledge about a statement (e.g., personality traits of a best friend, self, or high knowledge “Avery” condition), this statement is processed fluently even in the absence of photographs. The addition of a photograph in this case, will only contribute to a minimal amount of added fluency. On the other hand, when one does not possess much knowledge about the statement, the pairing of photographs is likely to have a greater impact on truth judgements (i.e., a larger truthiness effect) (Abed et al., 2017). This is because the amount of information primed by the photograph relative to that primed by other sources (i.e., related information primed by the statement from memory) is likely to be greater for situations in which individuals have lower (as opposed to greater) knowledge (Abed et al., 2017).

Additional support for the reasoning that it is the amount of information primed by the photographs relative to other sources about a target stimulus that elicits the truthiness effect was provided by Cardwell et al. (2016). Participants in this study were placed in either the “gave food” or “took food” condition where they were instructed to either give food to a particular animal or take food from them (e.g., “Give food to Shoebill” or “Take food from

Hammerkop") (Cardwell et al., 2016, p. 886). They were then asked to rate the truth of these claims (i.e., "I gave food to this animal" or "I took food from this animal") when familiar and unfamiliar animals were paired with and without photographs (Cardwell et al., 2016, p. 886). Photographs were found to exert stronger effects on truth ratings when they were paired with unfamiliar as opposed to familiar animals[9]. This finding was congruent with Abed et al. (2017)'s result that photographs had a greater influence in situations within which they can help bring forth relevant information (i.e., unfamiliar animals). Thus, while both the context in which stimuli are judged and pre-existing knowledge are important moderating factors, the presence of photographs appear to exert their effects in different ways in relation to these factors. For the former, the discrepancy in fluency between claims paired with photographs relative to a comparison standard results in the truthiness effect whereas in the latter, the amount of information primed by the photograph as opposed to other sources results in this effect.

In terms of the influence of fluency manipulations on truth ratings, the use of repetition and more recently, the use of photographs have received a lot of attention. However, any manipulation that facilitates elaboration has been shown to be used as a metacognitive cue for judging veracity (Reber & Schwarz, 1999; Reber & Unkelbach, 2010). The following section provides a brief overview of studies which have used other forms of fluency manipulations.

Other Fluency Manipulations

In a study conducted by Newman et al. (2012), not only did the pairing of photographs with the claim "This famous person is alive/dead" produce a truthiness effect but the use of verbal descriptions (i.e., non-probative information such as ethnicity, sex, hair, occupation of a person) paired with these claims also produced similar effects. Newman et al. (2014) on the

[9] This pattern of results was only observed in the "gave food" condition.

other hand, found easier names (as opposed to more difficult names) to be rated as more familiar and the claims paired alongside them to be evaluated more favourably. Another interesting study was by McGlone and Tofighbakhsh (2000) who presented participants with rhyming (e.g., "What sobriety conceals, alcohol reveals") and nonrhyming aphorisms ("Fools live poor to die rich") (p. 426). Modified versions of each of these two types of aphorisms were created by replacing one of the rhyming words with a synonym (i.e., Rhyming aphorisms: "What sobriety conceals, alcohol *unmasks*", nonrhyming aphorism: "Fools live poor to die *wealthy*") (McGlone & Tofighbakhsh, 2000, p. 426). Participants were assigned to either a control or warning condition in which they saw a mix of the modified and original versions of the rhyming and nonrhyming aphorisms for which they provided accuracy ratings (i.e., rate the degree to which you perceive the aphorism as "an accurate description of human behaviour") (McGlone & Tofighbakhsh, 2000, p. 425). As opposed to the control condition, participants in the warning condition were cautioned to judge the claims based on their accuracy and not on the poetic quality of the claims. While no difference in ratings were found for both the modified and original versions of the rhyming and nonrhyming aphorisms in the warning condition, individuals in the control condition were found to assign higher accuracy to the original rhyming aphorisms than their modified counterparts. Thus, the increased processing fluency associated with the rhyming aphorisms (as compared with the nonrhyming versions) was misattributed to the truth of these aphorisms, with warnings provided to participants significantly reducing this tendency (McGlone & Tofighbakhsh, 2000).

Likewise, Reber and Schwarz (1999) manipulated the colour contrast of statements to examine its effect on judgements. Participants in this study were shown statements with familiar (e.g., Lima, Teheran) or unfamiliar cities (e.g., Bolligen, Osorno); half of these statements were true while the other half was false. Statements were presented in highly

visible colours (i.e., blue, red) or moderately visible colours (i.e., green, yellow, and light blue). Highly visible statements were judged as more true compared to moderately visible statements. In all of the above studies, the use of any manipulation (e.g., colour contrast, rhymes, ease of names) that enhanced processing fluency influenced subsequent judgments on statements.

Having covered literature on both the illusory truth effect and the truthiness effect, the next section examines the topic of climate change to provide context for the current study. The review of literature thus far suggests pre-existing knowledge about a topic as a potential moderator for both the illusory truth effect and the truthiness effect. As such, it is important to understand the extent of knowledge individuals on average possess about climate change and the factors that influence their beliefs about this topic. Following this, an overview of the use of repetition and photographs in climate change communication and the effect they exert on understanding and evaluation of climate change information will be provided.

Climate Change Communication

Average knowledge and understanding of climate change. Climate change is a pressing issue that warrants more attention and concerted action (Price, Walker, & Boschetti, 2014). Scientific literature has not only shown irrevocable evidence for anthropogenic climate change but also the negative impacts it has on humans and the natural systems (IPCC, 2014). Majority of the individuals in developed countries such as the USA (Cook, 2017), New Zealand (Allan, 2017; Milfont et al., 2017), and the U.K. (e.g., Eurobarometer, 2014; Whitmarsh, 2011) are aware of climate change. However, research related to climate change risk perception has indicated that people are inclined to perceive climate change as a psychologically distant risk that might occur far in the future, impacting distant places and affecting people dissimilar to themselves (Jones, Hine, & Marks, 2017; Leiserowitz, 2004, 2006; Xiang, Zhang, Geng, Zhou, & Wu, 2019). For instance, data drawn from the New

Zealand Attitudes and Values Study (NZAVS) found a small but significant increase in the level of agreement among the New Zealand population regarding the reality of climate change and that climate change is caused by humans (Milfont et al., 2017). On the other hand, a national study conducted by Leiserowitz (2006) found that while a large proportion of Americans believe in the reality of climate change and its seriousness, it remains a low priority compared to other national and environmental issues. Although there has been little disagreement among experts regarding the anthropogenic causes of climate change, the desire for a balanced media coverage and misinformation has resulted in considerable disagreement among the masses (Cook, 2017; Lewandowsky, Ecker, Seifert, Schwarz, & Cook, 2012; Milfont et al., 2017; Nabi, Gustafson, & Jensen, 2018; Newell & Pitman, 2010; Weber & Stern, 2011; Whitmarsh, 2011). Whitmarsh (2011) conducted two postal surveys of the local population in the U.K. measuring the level of skepticism and uncertainty in regards to climate change between the years 2003 and 2008. While respondents were generally accepting of anthropogenic climate change, almost 40% of them indicated that there was no consensus among experts regarding whether climate change was caused by humans, with many acknowledging that the evidence regarding climate change is exaggerated by the media (Whitmarsh, 2011).

Factors influencing beliefs about climate change. Several factors including varying worldviews and values (Lewandowsky et al., 2012; Milfont et al., 2017; Sakellari, 2015; Van der Linden, 2015; Weber & Stern, 2011), cultural affiliations (Xiang et al., 2019), gender (Leiserowitz, 2006; Van der Linden, 2015), political ideology (Cook, 2017; Hornsey, Harris, Bain, & Fielding, 2016; Nabi et al., 2018; Van der Linden, 2015; Whitmarsh, 2011), and personal encounters (Van der Linden, 2015) are believed to influence an individual's beliefs about and attitudes towards climate change. Of these, political affiliations and individuals' values and worldviews have been consistently implicated as important determinants. In

examining the role of individual characteristics (among other variables) in climate change skepticism among the U.K. population, Whitmarsh (2011) found political affiliation, specifically, those who identified as conservative voters and had low pro-environmental values to express strong skepticism towards climate change. Similarly, Leiserowitz (2006) found females, minorities, and liberals as compared to whites, males, and conservatives in a U.S. cohort to perceive global warming as a greater risk.

Worldviews are described as a set of values or beliefs corresponding to different ways of relating to the world that are believed to dictate an individual's way of life (Dake, 1991; Price et al., 2014). Drawing on anthropological research on cultural theory, four different worldviews have been proposed: hierarchical, individualist, egalitarian, and fatalist (Dake, 1991; Price et al., 2014; Leiserowitz, 2006). Those who identify with the hierarchical worldview for instance, view behaviors against authority as threats, believe that nature is tolerant and will withstand damage to the extent that experts or authorities say it will (Dake, 1991). Individualists believe in self-regulatory actions, viewing any form of control as threats. According to them, nature is resilient and abundance created through "unfettered market mechanisms" (p. 67) will more than compensate for the damage inflicted on the environment (Dake, 1991). Egalitarians on the other hand, reject societal prescriptions and believe that nature is fragile and resources from it should be shared (Dake, 1991). In general, those with an egalitarian worldview have been shown to express more concern for the environment (Dake, 1991). Other studies have shown the values of self-transcendence and self-enhancement to be associated with concern for oneself (egoistic), concern for others (social-altruistic), or concern for the environment and animals (biospheric) (Schultz, 2001; Schultz et al., 2005). In particular, those who displayed more self-transcendence behaviours compared to self-enhancement behaviours also expressed biospheric concerns (Schultz et al., 2005).

Studies aimed at understanding how individuals process and react to climate change information (and misinformation) have predominantly focused on the role of emotions (e.g., hope/fear) and framing (e.g., gain/loss) in making climate change messages more persuasive (Lewandowsky et al., 2012; McCright, Charters, Dentzman, & Dietz., 2016; Nabi et al., 2018; Newell & Pitman, 2010). However, the use of repetition and in particular, the use of images are also prevalent within the domain of climate change communication. The next two sections examine how the use of repetition and photographs is implicated in this area.

Use of Repetition in Climate Change Communication

Climate change is a highly complex topic where not only is there a staggering amount of information available (Amelung et al., 2016) but also mixed evidence and misinformation. With the increasing infiltration of social media into everyday life, individuals are constantly exposed to information (and misinformation) on climate change (Lewandowsky et al., 2012). Given some support for the use of repetition in inducing attitude change (Cacioppo & Petty, 1979), repetition of climate change information across various media platforms have to a certain extent come to influence what an individual accepts and believes about this topic. Repetition has also been used to address and counter misinformation on climate change (Lewandowsky et al., 2012). Misinformation can be defined as any information that was initially presented to be true and is later realized to be false (Cook, Ellerton, & Kinkead, 2018; Lewandowsky et al., 2012). The presence of misinformation is pervasive within the climate change domain, whether be it a result of conservative think-tanks pushing for certain agendas and casting doubt on the legitimacy of climate science (Cook et al., 2018; McCright & Dunlap, 2010) or due to media and journalists aiming to present a ‘balanced’ story of climate change which promotes a misrepresented view of the seriousness of this issue (Lewandowsky et al., 2012). Repetition is one of the techniques used to retract or correct misinformation. Although the use of

repetition to completely eliminate misinformation has been shown to be difficult, this technique holds some promise (Lewandowsky et al., 2012). While to our knowledge, there have been no studies directly examining the use of repetition in relation to climate change, the use of repetition in fake news is relevant to the current study. Not only are both topics of personal relevance to individuals but they are also political in nature (Pennycook et al., 2018). As mentioned above, for a large majority in developed countries such as the U.S. and the U.K., attitudes and beliefs towards climate change are largely influenced by individual differences in political ideology (Cook, 2017; Hornsey et al., 2016; Nabi et al., 2018; Van der Linden, 2015; Whitmarsh, 2011). Given this, individuals may be more likely to examine the accuracy of climate change information (as opposed to relying on heuristic cues) in comparison to trivia statements since the former is of greater personal relevance (Pennycook et al., 2018).

Fake news. Pennycook et al. (2018) found evidence for the illusory truth effect within the context of fake news. Participants were exposed to experimental stimuli in three stages (Pennycook et al., 2018). Participants were randomly assigned to one of two conditions: the warning condition or the control condition. During the first stage, participants in the control condition were shown headlines for both real news and fake news; headlines were accompanied by an associated photograph, a lead statement and by-line below them (Pennycook et al., 2018). In the warning condition, all the fake news headlines (but not the real news headlines) were accompanied by a "disputed by 3rd party fact-checkers" tag. Participants were then required to indicate (No, maybe, yes) if they would share the story online. Following which, they completed a distractor task before proceeding to the final stage. In the final stage, they were shown both repeated and new headlines (half of which were real news headlines, the other half were fake news headlines) which they rated for familiarity (i.e., "Have you seen or heard about this story before?") and accuracy (Pennycook

et al., 2018, p. 1869). Repetition was found to increase perceived accuracy for both repeated fake and real news headlines as compared to novel headlines, this occurred even when fake news headlines were labelled with a "disputed by 3rd party fact-checkers" tag. This effect of repetition was found to be present even after a week (Pennycook et al., 2018). Thus, the use of repetition seems to influence individuals' perceptions of accuracy even in the context of fake news.

The Use of Photographs in Climate Change Communication

Visual images depicting climate change and its impacts have often been inter-woven with texts to increase awareness of climate change as well as to motivate action (O'Neill, Boykoff, Niemeyer, & Day, 2013). For example, O'Neill (2019) conducted a visual content analysis of climate change images that appear in popular news media (e.g., New York Times, Guardian) across the U.S. and the U.K. The use of visual images to portray climate change was found to have significantly increased over the years (between 2001 and 2007) with images on influential people (e.g., politicians), climate change impacts (e.g., flooding), and causes of climate change dominating this media platform. Affect, defined as "a person's good or bad, positive or negative feelings about specific objects, ideas or images" (Leiserowitz, 2006, p. 46) and particularly negative affect brought up by dramatic, fear-based images of climate change are common across mass media. These have not only been shown to be successful in capturing the attention of individuals but also useful in increasing risk perceptions in relation to climate change (Leiserowitz, 2006; O'Neill & Nicholson-Cole, 2009).

Two different information processing systems, the experiential processing system and the analytical processing system have been implicated in influencing one's attitudes and behaviours (Center for Research on Environmental Decisions [CRED], 2009). The experiential processing system which controls fight-flight behaviours, emotions and instincts

has been shown to be a stronger motivator of action (CRED, 2009; Marx et al., 2007). Stimuli that engage this processing system include imagery, personal experiences and real-world examples (CRED, 2009). The sole reliance on it however, is ineffective, with repeated exposures to emotionally evocative stimuli causing excessive worry or resulting in emotional numbing in the long run (CRED, 2009). The analytical processing system on the other hand, controls analysis of scientific information (CRED, 2009). Stimuli that target this processing system include graphs, probability information and trend analyses (CRED, 2009). While engaging this processing system is helpful in learning new information and decision-making, it alone is ineffective in compelling individuals towards taking action (CRED, 2009). Researchers from CRED, examined how different presentation modes that catered to these two different information processing systems influenced individuals' environmental attitudes, perceptions, and behaviours towards the effect of climate change on glaciers (Marx, Shome, & Weber, 2006). In order to do this, participants were either presented with scientific information in the form of imagery or through statistical information such as graphs (Marx et al., 2006). The results showed that people retained more factual information about the effects of climate change on glaciers after viewing the information targeting the experiential processing system (i.e., imagery) as compared to the analytical system (i.e., statistical information) (Marx et al., 2006).

Relatedly, Leiserowitz (2004) conducted a media content analysis for the movie "The Day After Tomorrow" among the U.S. adult population (sampling both "watchers" and "non-watchers") to examine the impact of motion pictures on public risk perception and behaviour. The movie depicts the shutdown of the North Atlantic thermohaline circulation system due to global warming that in turn triggers catastrophic weather events around the world (Leiserowitz, 2004). The first survey was conducted a week before the release of the movie while the second was done four weeks later. While in general, Americans did not appear to

be more concerned, perceive an increased likelihood of climate change impacts or engage in personal actions to combat climate change, the trend differed among moviegoers. Within this population, the movie appeared to have had a significant impact on climate change risk perceptions, with individuals expressing higher levels of concern about global warming. Thus, providing some evidence that the representation of climate issues through motion pictures or visuals can have an impact on public attitudes albeit temporary (Leiserowitz, 2004)[10].

Summary

Based on the current review of literature, there is evidence to suggest that both the use of repetition and the pairing of photographs alongside statements (particularly trivia) boosts processing fluency which in turn results in statements being rated truer than when these manipulations are not used. The use of fluency as a heuristic cue to make judgements is useful and ecologically valid given that individuals often learn from experience that there is a positive association between fluency and truth (since it is more common to encounter true rather than false statements) (Hawkins & Hoch, 1992; Reber & Unkelbach, 2010; Unkelbach, 2007). The process of attributing the feeling of ease to the truth of claims however, is an unconscious one (e.g., Whittlesea & Williams, 2000).

While slightly different in their underlying mechanisms, both the illusory truth effect and the truthiness effect utilize fluency as a cue when making truth judgements. Despite this similarity, studies have looked at the role of repetition and the use of photographs separately. It is however, more likely for one to encounter information that use more than one form of fluency manipulation such as with climate change communication. The use of imagery has

[10] Although the influence of motion pictures likely varies from that of static images, the purpose for referencing Leiserowitz's (2004) study is to show that imagery is widely used in communicating climate change information.

been deemed useful given its ability to motivate action (e.g., Lewandowsky & Whitmarsh, 2018; Newell & Pitman, 2010; Sakellari, 2015; Weber & Stern, 2011) whereas, repetition has been used as a way of countering and correcting misinformation on climate change. Understanding how these two fluency manipulations interact to influence truth judgements on climate change statements is thus, of practical value.

Furthermore, past studies have frequently used trivia statements given that both the illusory truth effect and the truthiness effect have been found to be stronger for unfamiliar statements (Bacon, 1979; Newman et al., 2012; Newman et al., 2015). While some have found pre-existing knowledge to moderate both the truthiness effect and illusory truth effect (e.g., Abed et al., 2017; Parks & Toth, 2006; Srull, 1983), others have found these effects to occur irrespective of knowledge (e.g., Arkes et al., 1989; Fazio et al., 2015). Given the inconclusive evidence, the current study aimed to understand how the use of photographs and repetition will influence truth ratings on climate change statements. Unlike trivia, climate change is a highly contentious issue for which a large base of opinions and information exists (Newell & Pitman, 2010). Given this, it would be useful to see if people are more prone to utilize cognitive heuristics rather than systematically look at the available evidence when making truth judgements (Hornsey et al., 2016). To our knowledge, no studies have looked into this particular area of study.

Study Aims and Hypotheses

Participants in this study will be required to rate a set of pre-tested climate change statements in two parts. In the first part (Time 1), participants will rate statements, half of which will be paired with non-probative photographs (as in studies examining the truthiness effect). In the second part (Time 2), participants will provide truth ratings to a mix of repeated statements from the first part of the study and new statements, none of which will appear with photographs (similar to studies examining the illusory truth effect). The current

study aims to explore 1) the cumulative effect of fluency manipulations on truth ratings of climate change statements and to 2) examine the effect of repetition and photographs separately in relation to truth ratings of these statements. In line with these aims, four hypotheses have been put forth: Hypothesis one: Climate change statements paired with photographs will be rated truer than those not paired with photographs at Time 1; hypothesis two: Repeated climate change statements will be rated truer than they were at Time 1; hypothesis three: Repeated climate change statements that were paired with a photograph at Time 1 will be rated truer than repeated statements not paired with a photograph at Time 1; hypothesis four: Repeated climate change statements will be rated truer than new statements at Time 2.

Chapter Three

Method

The aim of the present research was to examine the separate as well as the cumulative effect of two fluency manipulations, namely repetition and non-probative photographs on the truth ratings of climate change statements using a within-subjects design. The presence of photographs (i.e., statements paired with or without photographs) and the use of repetition (i.e., repeated statements or new statements) were the independent variables while the mean truth ratings of climate change statements was the dependent variable. Participants were required to provide truth ratings to 72 statements at Time 1 and 72 statements at Time 2. Truth ratings at both Time 1 and Time 2[11] occurred within the same session, with participants proceeding to complete part two of the study immediately following the completion of the first part.

Participants

Pilot study. A total of 40 participants were recruited online from Prolific Academic (http://www.prolific.ac) for the pilot phase of the study. Of these participants, 25 (62.5 %) were males and 15 (37.5 %) were females. The age range of participants was between 19 and 60 years old (M = 34.20, SD = 12.36).

Main study. Eighty participants were recruited from Prolific Academic for the main phase of the study. Of the sample, 53.8% (n = 43) were males and 46.3% (n = 37) were females. The mean age of participants was 30.85 years (SD = 10.86, range: 18-60 years).

[11] Time 1 and Time 2 are used synonymously with part one and part two of the study.

Measures

Demographic questions. Participants were screened only on the basis of age (i.e., 18 years and above) and first language (i.e., English) for the current study[12].

Climate change statements (pilot study). Given that past studies have mainly looked at trivia questions (e.g., Bacon, 1979; Newman et al., 2012; Newman et al., 2015), a new set of climate change statements were needed to be pre-tested for the current study. A total of 182 climate change statements were sourced from reliable sites such as Skeptical science, Meteorological (MET) office, Climate NASA, Real Climate, The Royal Society for the Protection of Birds (RSPB), National Wildlife Federation, The World Wide Fund for Nature (WWF), and the Open Source Systems, Science, Solutions (OSS) to be piloted. These sites provide information on climate change and its impact on the planet as well as address misinformation relating to this topic. Each of the statements selected has a definitive true or false answer. The purpose of the pilot study was to ensure that the final set of statements were ambiguous in terms of their truth status to participants, a condition deemed necessary for both the illusory truth effect and the truthiness effect (e.g., Bacon, 1979; Newman et al., 2012; Newman et al., 2015). Participants provided truth ratings for the statements on a 7-point scale: 1 = *completely certain false,* 2 = *somewhat certain false,* 3 = *tend to think false,* 4 = *unsure,* 5 = *tend to think true,* 6 = *somewhat certain true,* 7 = *completely certain true*. In order to ensure that the statements were ambiguous, only statements rated 3 (*tend to think*

[12] Additional details with regards to participants' gender, student status, country of birth, employment status, nationality, country of residence, time taken were also made available through Prolific Academic upon participants' completion of the study. However, except for age and gender for which the descriptives are provided, the other details were not of relevance to this study.

false), 4 (*unsure*), and 5 (*tend to think true*) were retained. A final set of 128 climate change statements were shortlisted to be used in the main study as a result. Of these, 59 were true statements (M = 4.99, SD = 1.23) and 69 were false statements (M = 3.45 , SD = 1.63). Thus, these statements were plausible without knowing with certainty whether they were true or false.

Climate change statements (main study). Studies on the illusory truth effect and the truthiness effect have used different study designs to examine these effects. Studies on the illusory truth effect (i.e., the use of repetition) measure the presence of this effect in a two-step process (Dechêne et al., 2010). The first step entails comparing the mean truth ratings of repeated statements at Time 2 and the same set of statements that appeared at Time 1. The second step looks at the difference in mean truth ratings between repeated statements and new statements at Time 2. Studies on the truthiness effect (i.e., use of photographs) on the other hand, compare the truth ratings of statements paired with and without a photograph in a single session (e.g., Newman et al., 2012). The current study used a combination of both study designs. In the first part of the study, participants provided truth ratings to a series of 72 climate change statements; half of the statements were paired with photographs while the other half was not. This was immediately followed by part two of the study where another 72 statements were presented. Half of these statements were repeated from the first part and the other half were new statements; none of these statements appeared with photographs.

To ensure an equal number of statements for both Time 1 (n = 72) and Time 2 (n = 72; 36 repeated statements from Time 1 and 36 new statements), only 108 statements from those that were shortlisted were used. Refer to Appendix B for the study questionnaire. In order to compare the effect of repetition and photographs on truth ratings, statements were grouped into the following seven categories: 36 statements at Time 1 that were paired with

photographs (T136photo), 36 statements at Time 1 that were *not* paired with photographs (T136nophoto), 18 statements at Time 1 that were paired with photographs (T1photo), 18 statements at Time 1 that were *not* paired with photographs (T1nophoto), 18 repeated statements from Time 1 that were previously paired with photographs (T2repeatedphoto), 18 repeated statements from Time 1 that were previously *not* paired with photographs (T2repeatednophoto), and 36 new statements that were used at Time 2 (T2new) (refer to Figure 3.1 for a breakdown of the statements). T1photo and T1nophoto are subsets of T136photo and T136nophoto respectively. T1photo and T2repeatedphoto consist of the same set of statements but statements at Time 2 do not appear with photographs. T1nophoto and T2repeatednophoto consist of the same set of statements.

The aforementioned labels were used in the creation of syntax for the planned comparisons (covered in the Results section) and were also used in the pre-registration on the Open Science Framework (OSF) database. As such, these labels were maintained to ensure consistency. Mean truth ratings were calculated for each of the seven categories of statements (i.e., For T136photo: truth ratings for all 36 statements at Time 1 that appeared with photographs were averaged into a single score). Each participant thus, had seven scores. Research randomizer (Urbaniak & Plous, 2013), an online randomization tool used to generate numbers through a complex algorithm, was used to randomly select these subsets of statements.

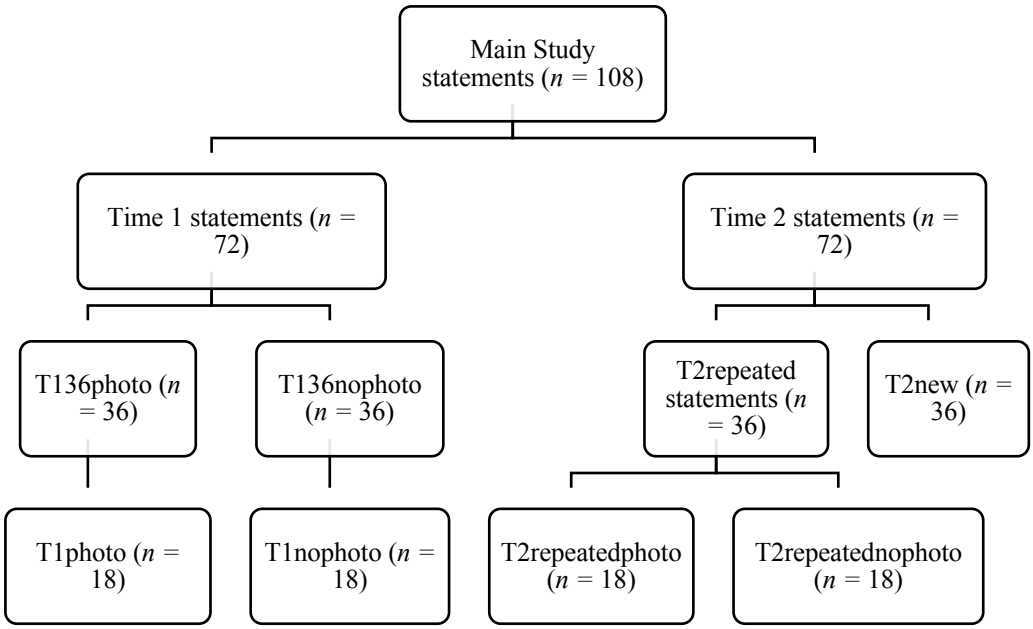

Figure 3. 1. Breakdown of climate change statements. T136photo = 36 statements at Time 1 that were paired with photographs; T136nophoto = 36 statements at Time 1 that were *not* paired with photographs; T1photo = 18 statements at Time 1 that were paired with photographs; T1nophoto = 18 statements at Time 1 that were *not* paired with photographs; T2repeatedphoto = 18 repeated statements from Time 1 that were previously paired with photographs; T2repeatednophoto = 18 repeated statements from Time 1 that were previously *not* paired with photographs; T2new = 36 new statements that were used at Time 2.

Climate change photographs. Photographs registered under a Creative Commons License were selected to be paired with the climate change statements. Photographs were selected such that they were non-probative, related to the statements but did not provide any evidence regarding the veracity of the statements. Photographs were searched based on the main topic of a statement. For instance, the statement "Warming waters cause corals to bleach" entailed searching for photographs on corals. Photographs were deemed appropriate

if they were sufficiently ambiguous, such that they were not indicative of a particular place (i.e., country, region etc.) unless it was the focus of the statement (e.g., "Antarctica is gaining sea ice but losing land ice at an accelerating rate"). Statements were paired with photographs only in the main phase of the study. An example of a statement paired with and without a photograph is shown in Figure 3.2 and Figure 3.3 respectively. Although statements were randomly selected to appear as true/false or repeated/new, only statements that could conjure up a relatively clear visualization of the topic of the statement or could bring up concrete images were selected to be paired with photographs. Hence, a statement "Flowers such as snowdrops are blooming earlier in the spring due to climate change" was selected to be paired with a photograph while a statement such as "Climate changes are part of a predictable, natural cycle that returns every 11,500 years" was not.

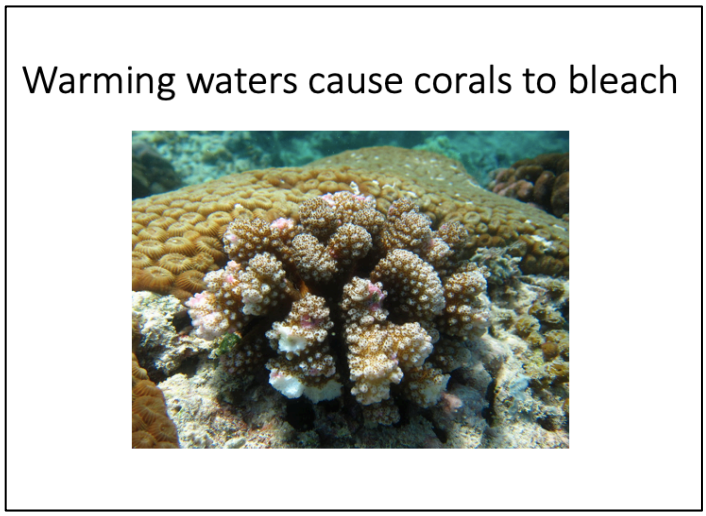

Figure 3. 2. Statement paired with a photograph.

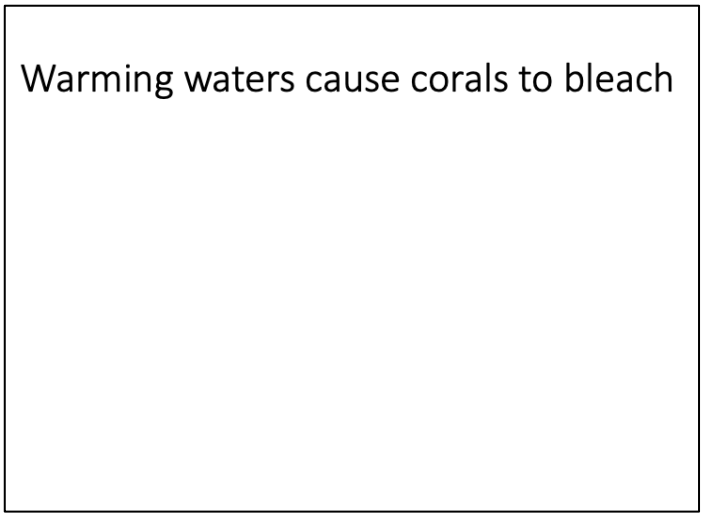

Figure 3. 3. Statement paired without a photograph

Free-response questions. Free-response questions were included at the end of the questionnaire to identify if participants were aware of the purpose of the study. These questions were adapted from Parks and Toth (2006) and Unkelbach (2007) and are as follows:

1. Did you use any strategies to rate the truth of the statements? If yes, what strategies did you use?
2. Did the presence of photos influence your judgements in any way? If yes, how?

Attention check questions. A total of three attention check questions were included among the final set of statements to ensure that participants were paying attention to the questions and not answering at random. The question was as follows: "It is important that you pay attention to this study. Please select … ". Each of the three questions required participants to select one of the following options: *strongly agree, strongly disagree, unsure, disagree, strongly disagree*. Participants who failed two of the three attention check questions were excluded from the study.

Sample Size Determination

In the current study, there were three primary analyses of interest. The first analysis aimed to examine the difference in truth ratings between statements paired with and without photographs. The second analysis involved two planned comparisons conducted within a one-way repeated measures Analysis of Variance (ANOVA) with four levels. The third analysis involved one planned comparison within a one-way repeated measures ANOVA with three levels. Both the aforementioned analyses (ANOVAs) aimed to examine the effect of repetition and the cumulative effect of both repetition and photographs on truth ratings of statements. Based on a sample size of 80, a correlation between factors = .3, a one-tailed *t*-test had 80% power to detect an effect size (Cohen d_z) of 0.28 (a small to medium-sized effect). Likewise, with a sample size of 80, the planned comparisons in both ANOVAs had 80% power to detect an effect size (eta squared) of 0.09 (i.e., a medium-sized effect). All sample size calculations were done using G*Power (Version 3.1)[13] (Faul, Erdfelder, Lang, & Buchner, 2007).

Sample Demographics and Testing Location

Prolific Academic was used to recruit participants for both the pilot and main study (Palan & Schitter, 2018). Prolific Academic is a crowdsourcing platform for online subject recruitment that is targeted at researchers (Peer, Brandimarte, Samat, & Acquisti, 2017; Palan & Schitter, 2018). It has been shown to have good recruitment standards with participants being provided with explicit information that they are being recruited for research participation (Palan & Schitter, 2018). It offers researchers higher transparency about the subject pool than on other platforms and allows screening on a range of dimensions before inviting subjects (Palan & Schitter, 2018). Peer et al. (2017) compared online crowdsourcing

[13] The method used to derive the sample size differed from the pre-registration, however, the sample size required to achieve the desired effect sizes were the same for both methods.

platforms such as MTurk, Prolific Academic, and CrowdFlower with a university-based online participant pool[14] as a comparison group across several dimensions. Prolific Academic was not only found to replicate existing findings on a range of common questionnaires and experimental tasks but also produced data quality better than CrowdFlower and the university subject pool (though comparable levels to MTurk). Furthermore, Prolific Academic was found to have a subject pool that was more diverse and naïve to common experimental tasks as compared to MTurk (Peer et al, 2017; Palan & Schitter, 2018).

Procedure

This research study was has been reviewed and approved by the Massey University Human Ethics. It has been pre-registered on the Open Science Framework (OSF) database (https://osf.io/xbnsf). The Qualtrics survey software was used to create the online questionnaire. A template available on Prolific Academic was integrated into the survey flow to make the questionnaire compatible with the Prolific platform. A set of pre-screening criteria (i.e., 18 years and above, English as the first language) was used to narrow down the pool of potential participants on Prolific Academic for both the pilot and main study. An additional exclusion criteria of having participated in the pilot study was applied for the main phase of the study. Participants who were eligible to take part were provided with an online summary of the study. Interested participants could then choose to participate in the study by clicking the study link provided. As this was an online study, prior to participating, individuals were required to read an information sheet detailing the nature of the study (Appendix C) and provide their consent to participate. Participants who were not keen to participate were automatically re-directed to the Prolific Academic platform. Based on Prolific Academic's minimum compensation rate of £5 per hour, participants in the pilot

[14] The Center for Behavioral Decision Research participant pool managed by Carnegie Mellon University

study were compensated with £5 whereas those in the main study were compensated with £2.50.

Pilot study. Participants read a set of instructions prior to commencing the study: "Please indicate the extent to which you think the following statements are TRUE/FALSE. Answer the questions as quickly as possible but not so quickly that you start making mistakes. Please answer the following questions from your own knowledge and refrain from searching for the answers online." Participants in the pilot study then proceeded to rate the climate change statements on a 7-point scale. None of the statements in the pilot study were paired with photographs given that the purpose of it was to generate a set of climate change statements that can be used in the main study.

Main study. The procedure for the main study phase was similar to the pilot study with slight variations. As this study involved a certain amount of concealment, this was made aware to the participants at the start of the study. Participants were not explicitly told that the purpose of the study was to examine how repetition and the use of photographs affected their truth ratings. Instead, they were told that the aim of the study was to look at how true or false they think the displayed statements are depending on their own knowledge. While the level of concealment was not predicted to have an adverse effect on participants, only those who provided consent to have the aims of the study withheld from them until the end of the study, were allowed to proceed with the study. The flow for the main study was adapted from the methodology sections of both studies on the illusory truth effect (e.g., Dechêne et al., 2010; Hasher et al., 1977) and studies on the truthiness effect (e.g., Newman et al., 2012). The main study phase was divided into two parts: Time 1 and Time 2.

Time 1. This first part of the study was similar to the studies on the truthiness effect whereby half of the statements was paired with non-probative photographs and the other half

was not (n = 72). Half of the statements were true while the other half was false. Statements were counterbalanced such that the true and false statements occurred equally often with and without photographs. Participants were required to rate the statements on a 6-point scale instead of a 7-point scale as in the pilot study: 1 = *completely certain false,* 2 = *somewhat certain false,* 3 = *tend to think false,* 4 = *tend to think true,* 5 = *somewhat certain true,* 6 = *completely certain true*. The mid-point 4 (*Unsure*) was removed given evidence for a stronger truth effect when using a 6-point scale instead of a 7-point scale (Dechêne et al., 2010). Statements remained on the screen until participants provided a response.

Time 2. Participants proceeded to the second part of the study immediately following the first part. Prior to providing truth ratings, participants were made aware in the instructions that some of the statements were repeated from the first part of the study while the rest were new. Participants were shown another set of 72 climate change statements. Half of these statements were repeated statements (i.e., 36 statements from Time 1) and the other half were new statements (i.e., 36 new statements). After providing truth ratings for these statements, participants were asked to complete two free-response questions. Following this, they were directed to a debrief section which explained to participants the study aims that were withheld from them at the start of the study and the purpose of the concealment. Participants were encouraged to contact the primary researcher through their Prolific account to discuss any further questions regarding the study.

Chapter Four

Results

Introduction

As mentioned earlier, the current study aimed to examine the cumulative effect that both non-probative photographs and repetition had on the truth ratings of climate change statements. It also aimed to examine if the truthiness effect and the illusory truth effect will be replicated when climate change statements are used instead of trivia statements. Data was analysed using the software programme Statistical Package for the Social Sciences (SPSS; version 26.0). Results will be presented in the following order: the first section will look at data exclusions based on the criteria pre-specified in the Open Science Framework (OSF) database, this will be followed by the assumptions for the analyses conducted in the current study and the steps taken to address any violations of assumptions. The next section will report the findings for a paired samples *t*-test and three planned comparisons which were conducted to examine the effect of repetition, the use of photographs, and the cumulative effect of both on the truth ratings of climate change statements. The planned comparisons conducted for the one-way ANOVA (four levels) were orthogonal. The final section will cover findings from the exploratory analyses.

Initial Data Check

Exclusions based on pre-registration. The following were the exclusion criteria as specified in the OSF pre-registration: Individuals were excluded if they did not respond to at least 80% of the statements, if they failed two or more of the three attention checks, if they provided answers in the free-response questions that were suggestive that they were aware of the study manipulations, and if they had extreme pattern responses (i.e., consistently rating-75% of the time towards one end of the scale: 1 = *completely certain false* or 6 = *completely*

certain true). Based on these exclusion criteria, four individuals were removed from the final analyses as they were aware of the manipulations, one person was removed because they indicated searching the internet for answers.

Outliers. Recommendations outlined by Pallant (2007) and Field (2018) were used to identify outliers. SPSS identifies outliers as points that extend between 1.5 and 3 times the interquartile range (IQ) (Pallant, 2007). Cases were also identified as outliers based on *z*-scores for the various dependent variables (Field, 2018). Overall, one participant appeared as an outlier consistently across the dependent variables based on the aforementioned recommendations and was removed from further analyses. Analyses were performed with and without the outliers; one with all the participants' data and one excluding the outliers identified. Given that findings for the two sets of analyses did not differ, the final set of analyses was conducted on the remaining sample ($N = 73$)[15]. Table 4.1 summarizes the demographic details of the final sample and Table 4.2 indicates the group means and standard deviations for the dependent variables.

Missing data points. Two participants had one missing data point each. Given that the mean truth ratings for the seven categories of statements was used in the analyses, pairwise exclusion was used in these instances.

[15] Data of one additional participant was removed at a later point when checking for the assumptions of normality for the paired-samples *t*-test.

Table 4. 1

Demographic Data for the Final Sample

Sex	*n*	Age Range	*M* (*SD*)
Male	40	18-60	30.60 (10.63)
Female	33	20-54	31.88 (11.28)
n Total	73	18-60	31.18 (10.87)

Table 4. 2

Means and Standard Deviations of Mean Truth Ratings by Statement Type

Statement Type	*n*	Mean Truth Rating[a] (*SD*)
T136photo	73	3.55 (.32)
T136nophoto	72	3.54 (.32)
T1photo	72	3.60 (.39)
T1nophoto	73	3.56 (.37)
T2repeatedphoto	72	3.60 (.34)
T2repeatednophoto	73	3.58 (.41)
T2new	73	3.52 (.36)

Note. T136photo = 36 statements at Time 1 that were paired with photographs; T136nophoto = 36 statements at Time 1 that were *not* paired with photographs; T1photo = 18 statements at Time 1 that were paired with photographs; T1nophoto = 18 statements at Time 1 that were *not* paired with photographs; T2repeatedphoto = 18 repeated statements from Time 1 that were previously paired with photographs; T2repeatednophoto = 18 repeated statements from Time 1 that were previously *not* paired with photographs; T2new = 36 new statements that were used at Time 2.

[a] On a 6-point scale: 1 = *completely certain false,* 2 = *somewhat certain false,* 3 = *tend to think false,* 4 = *tend to think true,* 5 = *somewhat certain true,* 6 = *completely certain true.*

Statistical Tests and Hypotheses

A combination of a paired-samples *t*-test and planned comparisons were conducted in the current study. In order to examine whether there was a truthiness effect caused by the inclusion of photographs, a paired-samples *t*-test was carried out. Mean truth ratings of statements paired with photographs were compared with those of statements not paired with photographs. Three planned comparisons were carried out to examine the effect of repetition as well as the cumulative effect of both repetition and photographs on the truth ratings of statements. The effect of repetition on truth ratings was examined in two steps. Firstly, mean truth ratings of statements repeated at Time 2 were compared with those of the same set of statements presented at Time 1 (Planned contrast 1). Next, mean truth ratings of repeated statements were compared with those of new statements (Planned contrast 2). In order to examine the cumulative effect of repetition and photographs, truth ratings of repeated statements that were previously paired with photographs (i.e., effect of repetition and photographs) and those of repeated statements that were previously not paired with photographs (i.e., effect of repetition) at Time 1 were compared (Planned contrast 3). The following section looks at the assumptions for these analyses and the steps taken to address any violations in these assumptions for the dependent variables. One-tailed tests were conducted for all analyses at $p < .05$.

Assumptions of Normality

Normality for *t*-test examining the truthiness effect. Assumptions of normality were tested for the distribution of the difference between truth ratings for statements that were paired with photographs (T136photo) and statements that were not paired with photographs (T136nophoto) at Time 1. Normality was assessed through Q-Q plots, skewness and kurtosis values and their respective *z*-scores, histograms, and the Kolmogorov-Smirnov test (Field, 2018). An absolute *z*-score value greater than 1.96 at $p < .05$ indicates significant

problems with skew and kurtosis (Field, 2018). Based on this, no significant issues with skewness (z-score$_{skew}$ = 1.02) and kurtosis (z-score$_{kurtosis}$ = 0.48) was found. In addition, the Kolmogorov-Smirnov test for the difference score did not deviate significantly from normal, $D(73) = .043$, $p = .200$. Examination of the Q-Q plot reflected a potential outlier, which was subsequently removed. Refer to figures D1 to D2 provided in Appendix D for the histogram and Q-Q plot for the difference in scores between statements paired with and without a photograph.

Normality for dependent variables used in planned comparisons. Univariate normality for the dependent variables was assessed. While Q-Q plots did not indicate major issues with normality, z-scores for skewness and kurtosis for T1nophoto (z_{skew} = 1.28, $z_{kurtosis}$ = 1.30) and T2repeatednophoto (z_{skew} = -2.09, $z_{kurtosis}$ = 3.77) revealed significant problems (an absolute z-score greater than 2.58 is significant at $p < .01$) (Field, 2018). The distribution for majority of the variables indicated a positive skew (i.e., accumulation of scores on the left) with the exception of T2repeatednophoto. All except for the distribution of scores for T1photo had a positive kurtosis (i.e., heavy-tailed distribution). The Kolmogorov-Smirnov test for all the dependent variables were significant, indicating that the scores did not deviate significantly from normal (refer to figures E1 to E10 in Appendix E for the histograms and Q-Q plots).

Effect of Photographs on the Mean Truth Ratings of Statements

In order to determine if the pairing of photographs increased the truth ratings of statements, a paired samples t-test with bootstrapping was conducted. The mean truth ratings provided for statements paired with photographs (M = 3.55, SE = .037) did not differ from the truth ratings provided for statements not paired with photographs (M = 3.54, SE = .037) at Time 1. This difference was not significant, $t(71) = .28$, $p = .782$, bias corrected and

accelerated (BCa[16]) 95% CI [-.048, .065] and had an effect size[17] of $d = 0.025$. The pairing of climate change statements with photographs did not appear to have an influence on the truth ratings of the statements. Thus, hypothesis one was not supported.

Effect of Repetition on Truth Ratings of Statements

Two planned comparisons[18] were carried out using the MMATRIX subcommand to examine the effect of repetition on truth ratings. The first comparison looked at the difference in truth ratings between combined Time 1 statements (Variable cluster 1: T1photo, T1nophoto) and the same set of statements at Time 2 (Variable cluster 2: T2repeatedphoto, T2repeatednophoto). A weight of 1 was assigned to both T1photo and T1nophoto each while a weight of -1 was assigned to each T2repeatedphoto and T2repeatednophoto. Higher truth ratings for Time 2 statements as opposed to Time 1 statements fulfils one of the two criteria for the presence of an illusory truth effect. The planned comparison indicated no significant difference in mean truth ratings between the combined Time 1 statements (Variable cluster 1) and the same set of statements at Time 2 (Variable cluster 2), $F(1, 70) = .11$, $p = .746$, 95% CI [-.117, .084]. Hypothesis two was not supported given that Time 2 statements did not receive higher truth ratings than Time 1 statements. In other words, the first criterion for the presence of an illusory truth effect was not satisfied.

A second planned comparison was used to compare the mean truth ratings between repeated and new statements. In order to do this, the two categories: repeated statements at

[16] Refers to bootstrap confidence intervals.

[17] Refers to Cohen's *d*. A value of 0.2 indicates a small effect, a value of 0.5 indicates a medium effect, and a value of 0.8 indicates a large effect (Field, 2018).

[18] All planned comparisons were conducted within one-way ANOVAs. The omnibus tests did not provide tests of any of the hypotheses and are thus not reported here.

Time 2 that had previously been paired with photographs and repeated statements at Time 2 that had previously not been paired with photographs were combined into a singular group of repeated statements (Variable cluster 1: T2repeatedphoto, T2repeatednophoto) and compared against the truth ratings of new statements (T2new). A weight of ½ was assigned to each T2repeatedphoto and T2repeatednophoto and a weight of -1 was assigned to T2new. Higher truth ratings for repeated statements as compared to new statements fulfils the second criteria for the presence of an illusory truth effect. Repeated statements (M = 3.59, SD = .33) were found to have significantly higher truth ratings that new statements (M = 3.52, SD = .36), $F(1, 71) = 11.05$, $p = .001$, 95% CI [.032, .128]. Thus, the second criterion for the presence of an illusory truth effect was satisfied and hypothesis four[19] was supported.

Cumulative Effect of Fluency Manipulations on Truth Ratings of Statements

In order to examine the cumulative effect of repetition and photographs on truth ratings, a third planned comparison was conducted. Repeated statements that were previously (at Time 1) paired with photographs (T2repeatedphoto) were compared with repeated statements that were *not* previously paired with photographs (T2repeatednophoto). A weight of 1 was assigned to T2repeatedphoto and a weight of -1 to T2repeatednophoto. The mean truth ratings for statements that were earlier paired with photographs at Time 1 did not differ significantly from the truth ratings of statements that were not earlier paired with photographs at Time 1, $F(1, 70) = .720$, $p = .399$, 95% CI [-.048, .118]. Thus, no support was found for

[19] The numbering of hypotheses for the effect of repetition (illusory truth effect) is not consecutive as the planned comparisons for hypothesis two (for the effect of repetition) and hypothesis three (for the cumulative effect of fluency manipulations) were examined together within a one-way ANOVA, whereas the planned comparison for hypothesis four was examined using another one-way ANOVA.

the cumulative effect of fluency manipulations on truth ratings; hypothesis three was not supported.

Additional Exploratory Analyses

Although the climate change statements in the current study included both true and false statements (as in past studies), the analysis of differences of the effect of repetition and photographs according to the true and false status of the statements was not done, given that this was not the focus of this study. Past studies such as Hasher et al. (1977) for instance, have found some differences between true and false repeated and non-repeated statements. Given that the truth ratings for both true and false statements in this study were combined, it is possible that any difference in ratings between true and false statements could have been masked. Examining the effect of fluency manipulations according to the truth status of statements allows one to see if these manipulations have a differential impact on true and false statements or if they influence statements irrespective of their truth status.

Effect of repetition and truth status of statements. In order to examine if the truth status of statements interacts with repetition, a 2 (Repetition: repeated, new) by 2 (Truth Status: true, false) factorial repeated measures ANOVA was conducted. A violation to the assumption of normality was noted for the truth ratings of true, new statements (z_{skew} = 1.20, $z_{kurtosis}$ = .51) and true, repeated statements (z_{skew} = -2.73, $z_{kurtosis}$ = .51). The Kolmogorov-Smirnov test for the truth ratings of true, new statements also revealed a significant departure from normality; $D(73) = .12$, $p = .012$. However, given that this was an exploratory analysis and the group sizes were relatively small (n = 18 for each true repeated statements, false repeated statements, true new statements, false new statements), this was expected. A

significant main effect for repetition was found, $F(1, 71) = 11.05$, $p = .001$, $r_{\text{repeated vs, new}}$[20] = .37. Repeated statements ($M = 3.59$, $SE = .039$) were rated higher in terms of truth than new statements ($M = 3.51$, $SE = .041$). There was also a significant main effect for the truth status of statements, $F(1, 71) = 104.86$, $p < .001$, $r_{\text{true vs, false}} = .77$. True statements ($M = 4.04$, $SE = .049$) received higher truth ratings than false statements ($M = 3.05$, $SE = .072$). However, no interaction effect was observed between repetition and the truth status of statements, $F(1, 71) = .44$, $p = .51$, $r_{\text{repeated vs, new, true vs. } false} = .078$ (refer to Figure 4.1). Thus, the higher truth ratings for true statements as compared to false statements was equivalent for both repeated and new statements.

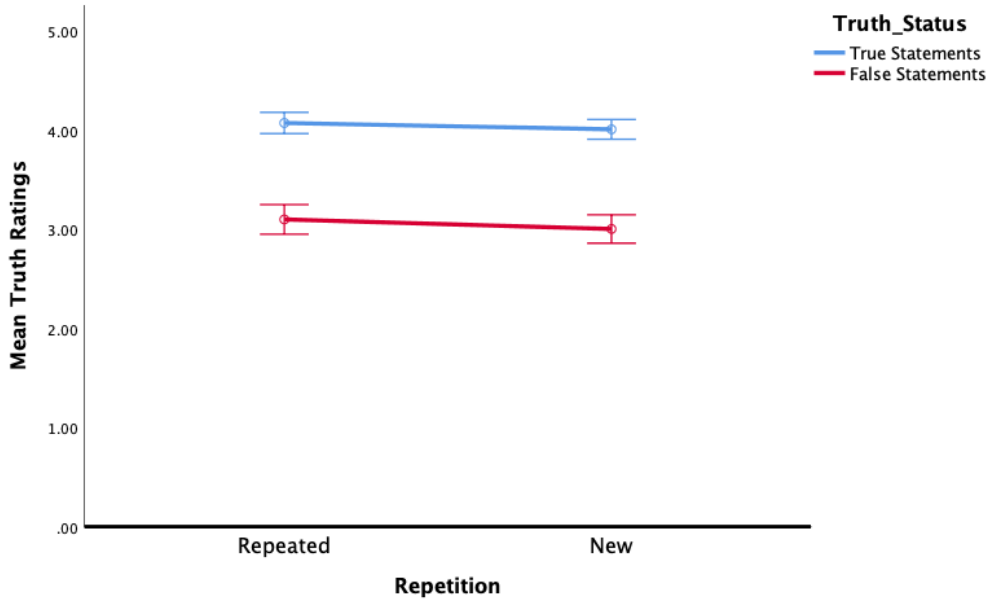

Figure 4. 1. Truth ratings (estimated marginal means) and 95% confidence intervals for the interaction between repetition and the truth status of statements.

[20] Denotes Pearson's *r;* a value of 0.10 denotes a small effect size, a value of .30 denotes a medium effect size and a value of 0.50 denotes a large effect size (Field, 2018).

Effect of photographs and truth status of statements. In order to examine the interaction between the presence of photographs and the truth status of statements, another 2 (Photographs: photographs, no photographs) by 2 (Truth Status: true, false) factorial repeated measures ANOVA was conducted. Violations of assumptions to normality based on *z*-scores was noted for both true (z_{skew} = -2.63, $z_{kurtosis}$ = 3.01) and false statements (z_{skew} = -2.56, $z_{kurtosis}$ = .80) that were not paired with photographs. The Kolmogorov-Smirnov test for false statements that were not paired with photographs also indicated a significant departure from normality; $D(72) = .12$, $p = .016$. Once again, given the relatively small cell sizes and the exploratory nature of the analysis, this was expected. A significant main effect was only found for the truth status of statements, $F(1, 71) = 137.39$, $p < .001$, $r_{true\ vs.\ false} = .81$; true statements ($M = 4.02$, $SE = .042$) received higher truth ratings than false statements ($M = 3.07$, $SE = .063$). The main effect of photographs was not significant, $F(1, 71) = .077$, $p = .782$, $r_{photo\ vs.\ no\ photo} = .033$; statements paired with photographs ($M = 3.55$, $SE = .038$) did not differ significantly from statements not paired with photographs ($M = 3.54$, $SE = .038$). However, a significant interaction effect was observed between the presence of photographs and the truth status of statements, $F(1, 71) = 17.34$, $p < .001$, $r_{photo\ vs.\ no\ photo,\ true\ vs.\ false} = .44$. The interaction graph (Figure 4.2) shows that the presence of photographs resulted in true statements being rated as more true and false statements to be rated as more false.

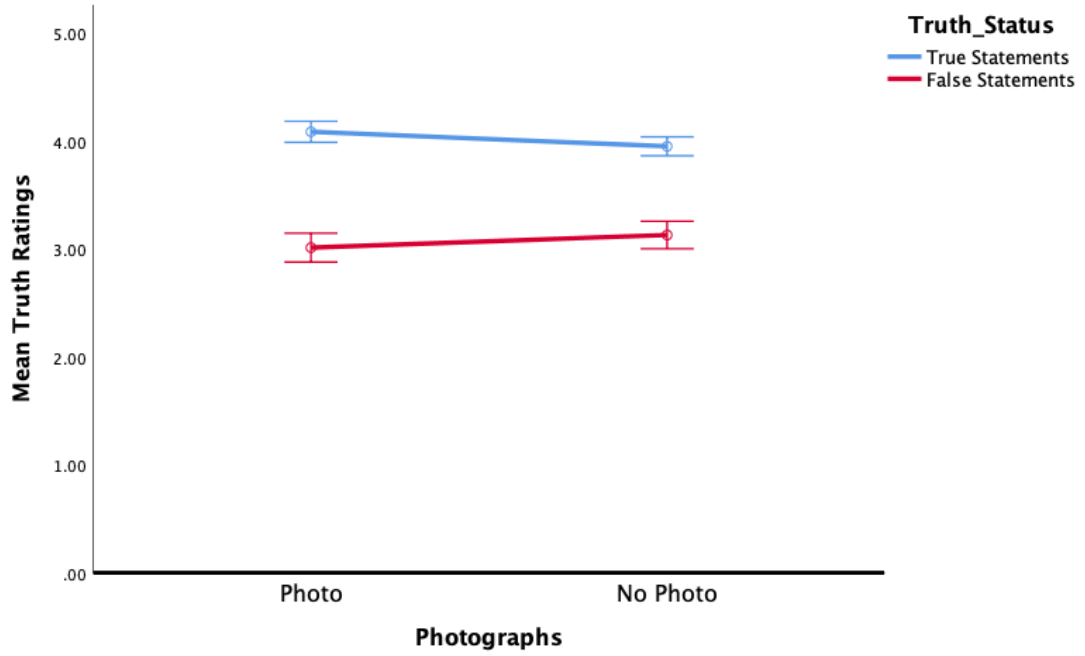

Figure 4. 2. Truth ratings (estimated marginal means) and 95% confidence intervals for the interaction between the presence of photographs and truth status of statements.

Summary

Data analysis for the current study focused on comparing the mean truth ratings across the different groups of climate change statements. In particular, mean truth ratings of statements paired with photographs were compared with those of statements not paired with photographs and mean truth ratings of statements that were repeated were compared against those that were new. In doing so, the aim was to examine separate as well as the cumulative effects of repetition and the use of photographs on truth ratings of statements. The only significant effect found was that of repeated statements being rated truer than new statements. Thus, while repetition seemed to have an effect on truth ratings of climate change statements (albeit limited), the influence of photographs did not. Moreover, no support was found for the cumulative effect of both fluency manipulations on truth ratings of statements.

The exploratory analyses showed that the effect of repetition on truth ratings did not differ according to the truth status of statements. In contrast, a significant interaction effect of the truth status of statements and the presence of photographs was observed. In particular, true statements received higher truth ratings than false statements; this pattern of rating was more prominent when statements appeared with photographs as opposed to when they appeared without photographs. These findings are however exploratory, and require additional research before stronger conclusions can be drawn. An analysis of the findings from the main study and the exploratory analyses will be covered in the following section together with a discussion of implications and avenues for further research.

Chapter Five

Discussion

Overview

Past literature has examined how fluency manipulations influence information processing and judgements of claims. In particular, the use of repetition has been shown to enhance the truth ratings of repeated statements as compared to new statements (i.e., the illusory truth effect) (e.g., Bacon, 1979; Hasher et al., 1977) while the pairing of non-probative photographs with claims has been shown to bias individuals towards rating these claims as more true as opposed to when they are not paired with photographs (i.e., the truthiness effect) (e.g., Newman et al., 2012). Despite the two phenomena having similar proposed underlying mechanisms, studies have examined both these effects in isolation. Several of these studies have also focused on the use of trivia statements given that the ambiguous nature of these statements is considered crucial for the occurrence of both the illusory truth effect and the truthiness effect (e.g., Bacon, 1979; Newman et al., 2012).

The current study aimed to extend existing research in these two areas to the domain of climate change communication. It is common for information on climate change to be presented in various ways including being paired with images, repetition, and the use of different frames (e.g., gain/loss frames) to influence the way in which this information is received by individuals (Lewandowsky et al., 2012; McCright et al., 2016; Nabi et al., 2018; Newell & Pitman, 2010). It is unlikely however, that any one of these fluency manipulations used exert their effects in an isolated manner. As such, one of the main aims of this study was to understand if the use of two forms of fluency manipulations, namely repetition and photographs would result in a greater effect on truth judgements (i.e., higher mean truth ratings) as compared to a single fluency manipulation. In addition, it sought to examine if the

truthiness effect and the illusory truth effect will replicate when other forms of statements such as climate change claims are used instead of trivia statements. This chapter covers the findings in relation to the four hypotheses that were put forth. The first section of this chapter will discuss the findings in relation to the truthiness effect, the illusory truth effect, and lastly the cumulative effect of fluency manipulations in relation to the truth ratings of climate change statements. This will be followed by the limitations of the current study and recommendations for future research. Following which, findings from the exploratory analyses and recommendations based on these will be discussed. The last section will conclude with a summary of the findings from the current study.

The Truthiness Effect

Past studies have shown that when individuals judge the truth of claims, the presence of non-probative photographs tends to enhance the subjective truth of those claims (Fenn et al., 2013; Mangus, 2018; Newman et al., 2012; Newman et al., 2015). The presence of photographs has been suggested to influence truth judgements in various ways. Firstly, photographs are believed to increase the credibility of information they are paired with (Newman et al., 2012). For instance, McCabe and Castel (2008) found that participants rated fictional and real articles on cognitive neuroscience research paired with brain images significantly higher in terms of scientific merit (e.g., how well written the article was, whether the scientific reasoning was sound) compared to when they were paired with a bar graph, a topographical map of the brain, or a no image control condition, showing that images play an important role in increasing persuasiveness of data which accompany them. Secondly, photographs help to provide a rich semantic context which helps to prime relevant thoughts and images related to the claim, which in turn help foster belief in it and increase the subsequent truth ratings (Newman et al., 2015). More importantly, the discrepancy in the ease of processing between statements paired with and without photographs has been shown to be

one of the main factors driving the truthiness effect (Whittlesea & Williams, 1998, 2000). Newman et al. (2015) illustrated this by manipulating the presence of photographs within and between-subjects. In the within-subjects condition, individuals were shown trivia statements that were either paired with a related photograph, unrelated photograph, or no photograph and asked to provide truth ratings. In the between-subjects condition, a third of the participants viewed statements paired with related photographs only, a third saw statements with unrelated photographs only, and a third saw statements without any photographs. A truthiness effect was only found for the within-subjects condition whereby statements paired with related photographs were rated truer than those paired with unrelated or no photographs. This effect was not observed in the between-subjects condition. The comparison of statements paired with photographs with those not paired with photographs in the within-subjects condition produces a discrepancy in fluency. This discrepancy however, is absent when statements appear only with photographs alone. In other words, the presence of a comparison standard such as a statement not paired with photograph causes a statement paired with a photograph to be processed more fluently (Whittlesea & Williams, 1998, 2000). This ease in processing is then misattributed to the truth of the claims causing statements paired with photographs to receive higher truth ratings compared to their no photograph counterparts (Whittlesea & Williams, 1998, 2000).

In the current study, statements paired with photographs appeared amidst those not paired with photographs. Despite the expected discrepancy in fluency, the presence of photographs did not have an effect on the truth ratings of climate change statements. Several possible reasons can account for this insignificant finding, including pre-existing knowledge, a weak association between the photograph and the statement, and the neutral nature of images used. Each of these points will be explored in the following sections.

Pre-existing knowledge for climate change statements. A majority of studies conducted on the truthiness effect have utilised trivia statements (e.g., Fenn et al., 2013; Newman et al., 2012; Newman et al., 2015) with the exception of some studies which used "dead or alive claims" (e.g., "This famous person is alive" or "This famous person is dead") (Newman et al., 2012, p. 969), "I gave food to this animal-true or false" (Cardwell et al., 2016, p. 886), and personality traits (Abed et al., 2017). One of the main reasons for the use of trivia statements is the need for statements to be ambiguous (Mangus, 2018; Newman et al., 2012). This is because, the truthiness effect has been shown to be stronger for unfamiliar, uncertain claims which are also conditions that predispose individuals to rely on heuristic cues or be susceptible to fluency manipulations (Cardwell et al., 2016; Newman et al., 2012; Newman et al., 2015; Tversky & Kahneman, 1974; Unkelbach, 2007). Although climate change statements in the current study were pre-tested for ambiguity, these statements differed from trivia statements in important ways. Unlike trivia claims, the topic of climate change is a highly salient one, with it receiving an extensive amount of coverage across various media platforms (Amelung et al., 2016; O'Neill, 2019). Given this, it is likely that individuals already had some pre-existing knowledge about the topic which in turn resulted in the pairing of non-probative photographs not having an additional impact in terms of added fluency (Abed et al., 2017). For instance, Abed et al. (2017) examined if people's judgements of whether a personality trait was characteristic of an individual was affected by the amount of background knowledge they had about the person. This was done by asking participants to rate how characteristic a personality trait (e.g., clumsy) was of either themselves, a best friend or a hypothetical person of whom they did not have any background knowledge. Some of these personality traits appeared with photographs whereas others did not. Truth ratings for personality traits were significantly higher when they were paired with photographs (as opposed to when they were not) for the hypothetical person (Abed et al., 2017). The presence

of photographs however, was not found to make a difference for both the self and best friend conditions (i.e., conditions in which the participant had a lot of background knowledge about the person). According to Abed et al. (2017), the presence of photographs has a greater influence on truth judgements in situations where one does not have much background knowledge about the stimuli. Pairing a photograph with a claim in the above scenario (i.e., self and best friend conditions) enhances fluency minimally as the claim is believed to be processed fluently (given the background knowledge) even in the absence of it. This might have been the case for climate change statements where pre-existing knowledge might have reduced the influence of photographs.

Relatedly, there might have been a self-selection bias such that individuals who possessed greater knowledge on climate change, had stronger opinions, or were more invested in the topic could have participated in the study. In this case, there is a higher likelihood that these individuals were already highly aware of the topic and thus, photographs might not have contributed to any added fluency (Abed et al., 2017) or if they did, only minimally.

Affect-laden images versus neutral non-probative images. Relevant to the discussion of photographs is the type of photographs that were used in this study. Based on previous studies on the truthiness effect (e.g., Newman et al., 2012; Newman et al., 2015), non-probative photographs were used to pair the climate change statements in the study. These photographs were related to the semantic content of the statement but provided no information regarding its veracity (Newman et al., 2012; Newman et al., 2015). Although images are widely used in climate change communication (e.g., Leiserowitz, 2006; O'Neill, 2019; O'Neill & Nicholson-Cole, 2009), the type of images used within this domain tends to be emotionally evocative and in particular, fear-inducing and negative (e.g., a polar bear stranded on an isolated iceberg or bleached coral reefs) (O'Neill & Nicholson-Cole, 2009).

In examining how issues of climate change are represented and how this influences individuals' engagement with the issue, O'Neill and Nicholson-Cole (2009) found participants to report images that displayed catastrophic consequences of climate change such as human or animal suffering to be those that increased the saliency and importance of climate change for them. By contrast, images that were positive, ambiguous (e.g., sunflower crops), or unrelated were found to be less influential in conveying a sense of urgency and importance in relation to climate change. The use of affect-laden images, particularly those of a negative valence, has been shown to be a successful strategy (albeit unsustainable in the long run) to capture the attention of individuals and motivate action to combat climate change (Leiserowitz, 2006; Morris et al., 2019; O'Neill, 2019; O'Neill & Nicholson-Cole, 2009). These types of images target the experiential processing system which controls fight-flight behaviors, instincts, and emotions and has been shown to be a stronger motivator of action as opposed to the analytical processing system (CRED, 2009; Marx et al., 2007). The photographs used in this study though associated with the topic of the statement, were primarily neutral in terms of affect. Thus, it is possible that these photographs may not have been pivotal in influencing truth ratings or that individuals relied less on them given that these types of images are encountered less frequently (compared to fear-inducing images) in the context of climate change information.

An equally likely explanation for the null effect of photographs could be due to most statements expressing the negative consequences of climate change. In Newman, Azad, Lindsay, and Garry's (2018) study, participants who viewed positive and negative claims paired with photographs of commodities ("This commodity is likely to have increased/decreased in price three months from today") (p. 2) were found to rate positive claims truer than negative claims. In other words, photographs were found to lead people to believe in positive claims (i.e., increase in price) but have a small effect on negative claims

(i.e., decrease in price). Given that a substantial portion of climate change statements described the negative consequences of climate change, the resulting negative emotions may have reduced or overshadowed the truthiness effect (also see Koch & Forgas, 2012[21]).

Weak association between statements and photographs. Likewise, the association between the presence of a photograph and the statement might have been weaker when using climate change items. This might be because climate change is a contentious topic that engenders strong opinions and perspectives (Cook, 2017; Milfont et al., 2017; Nabi et al., 2018; Weber & Stern, 2011). In particular, views and beliefs about the reality of climate change and its causes has been shown to be heavily influenced by factors such as political ideologies (especially in developed countries such as the U.S. and the U.K.) (Cook, 2017; Hornsey et al., 2016; Leiserowitz, 2006; Nabi et al., 2018; Van der Linden, 2015; Whitmarsh, 2011), worldviews, and values held by individuals (Dake, 1991; Price et al., 2014). Thus, it is possible that while photographs may still have been an important consideration while providing truth ratings for statements, the aforementioned factors such as the political party one identifies with, the level of concern one has for the environment (i.e., biospheric concern), and values such as self-transcendence (i.e., characterized by values such as universalism and benevolence) may be more influential determinants of truth ratings (e.g., Cook, 2017; Dake, 1991; Schultz et al., 2005). The influence of these factors however, could not be clarified as they were not measured in the current study. Interestingly, a closer look at participants' comments for the free-response question "Did the presence of photographs affect your response?" showed four out of 80 participants to indicate that the presence of photographs helped increase the tendency to believe in the statement presented. Hence, while it is likely that photographs still influenced how participants rated the statements, this

[21] This study refers to the illusory truth effect but is relevant to the consider in relation to the truthiness effect.

influence might be limited for climate change statements given the other more influential factors.

The Illusory Truth Effect

Fluent processing resulting from repetition produces feelings of familiarity which is often used as a cue for truth when rating statements (e.g., Dechêne et al., 2010). According to the discrepancy-attribution hypothesis, it is the difference between the actual processing fluency and one's expectation that results in this feeling of familiarity (Whittlesea & Williams, 1998). Dechêne et al. (2010) proposed two contexts in which a discrepancy in fluency can occur. In a heterogenous context, a mixture of repeated and non-repeated statements is used. In this context, repeated statements are more likely to be processed fluently as compared to non-repeated statements, this discrepancy (i.e., greater fluency in processing for repeated statements as compared to the non-repeated statements) is used as a cue to inform truth judgements. This difference in fluency is however, less evident in a homogenous context where the same set of statements is used. Here, statements' average fluency can be used as a standard against which other statements are compared (Dechêne et al., 2010). In line with this, the presence of an illusory truth effect in the present study was examined in two steps. The first step entailed comparing the truth ratings of statements at Time 1 with those of the same set of statements at Time 2 (i.e., the homogeneous context). The second step involved the comparison between the truth ratings of repeated statements and new statements (i.e., the heterogenous context). The higher mean truth ratings at Time 2 (as opposed to Time 1) and the higher truth ratings for repeated statements (compared with new statements) indicates the presence of an illusory truth effect. Support was only found for one of the two comparisons in the current study.

Comparison of Mean Truth Ratings between Time 1 and Time 2 Statements

No significant difference in mean truth ratings was found between statements rated at Time 1 and the same set of statements rated at Time 2. This was at odds with previous studies such as Dechêne et al. (2009) who randomly assigned participants to either the mixed list condition, the all-old condition, or the all-new condition. In the first session, all participants rated a set of trivia statements. In session two, participants in the mixed-list condition were presented with a list of both repeated and new statements, those in the all-old condition rated the same statements they saw in session one, and those in the all-new condition rated only new statements. Repeated statements in the mixed-list condition were rated more true in session two (M = 4.30 on a 7-point scale) than in session one (M = 3.75), this however, was not found in the all-old and all-new conditions. Likewise, Arkes et al. (1989) found a significant increase in validity ratings from Trial 1 (M = 4.00, on a 7-point scale) to Trial 2 (M = 4.12) for a mix of true, false, and socio-political opinion statements. These two studies however, had sessions spaced one-week apart as opposed to the current study where participants proceeded to complete the second part of the study immediately after completing the first part. This short interval between sessions could not only have facilitated the recollection of statements from the first part of the study but also led to the discounting of fluency, both of which will be covered below.

Source recollection and recognition. Longer intervals between presentations of statements is often associated with a decline in source memory (Arkes et al., 1991; Begg et al., 1992; Brown & Nix, 1996). This not only decreases the tendency to recollect the source of the statements but also enhances the effect of fluency manipulations (Arkes et al., 1991). It is highly likely that the short interval between sessions facilitated the recollection of statements (Bacon, 1979). Additionally, this could have caused participants to remember and stick to these responses during the second rating so as to avoid "time-consuming extra

processing" especially over a short time interval (also known as decision inertia) (Nadarevic & Erdfelder, 2014, p. 80; Bacon, 1979). Although the truth effect has been shown to be a robust phenomenon that occurs irrespective of the length of interval between sessions, many of these studies have focused on comparing the truth ratings between repeated and new statements as opposed to between Time 1 and Time 2 (Fazio et al., 2015; Schwartz, 1982).

One such study that examined the effect of a short interval on Time 1 and Time 2 truth ratings was by Nadarevic and Erdfelder (2014). Participants in this study were asked to provide validity ratings for trivia statements on three different occasions, with the first two sessions spaced ten minutes apart and the last session taking place a week later. In the first session, participants were shown a set of statements for which they provided validity ratings and rated them for interestingness on a 6-point scale. Following a 10-minute interval of filler tasks, they were asked to provide truth ratings for repeated as well as new statements; one week later, truth ratings were once again provided. Similar to my study, a truth effect was not found after a 10-minute interval (i.e., statements at Session 2 did not receive higher truth ratings than statements at Session 1). However, it is important to note that Nadarevic and Erdfelder (2014), found the validity ratings for Session 2 to be lower than those at Session 1 instead (M = 3.63 vs. 3.59); this difference was significant.

Discounting of fluency. Although according to the discrepancy-attribution hypothesis, repeated statements at Time 2 should have been rated higher in terms of truth as compared to the same set of statements at Time 1, Jacoby and Whitehouse (1989) found that when individuals are aware of the reason behind the fluent processing of a stimulus, they might discount this fluency. Jacoby and Whitehouse (1989) presented participants with a list of words which they were asked to remember for a later recall. Following this, participants were presented with test words (a combination of old words from the previous list and new words) and were asked to determine if the word had been studied earlier. Each test word was

either preceded by a context word or by a series of letters (xoxoxox; baseline condition). These context words were either a match or a non-match to the test words. Awareness of the context words were manipulated through the presentation duration of the context word. Participants in the *aware* condition were presented with the context words for 200ms whereas those in the *unaware* condition were presented with the context words for 50ms. According to the authors, if participants were *aware* of the presentation of the context word that matched the test word, they would be less likely to call the test word "old". This is because the familiarity for the test word would be attributed to the fact that the word had just been read as a context word. An opposite pattern was expected for the *unaware* condition. Familiarity in this study was assessed through the probability of a false recognition (i.e., calling a new test word "old"). In line with the predictions, new test words were less likely to be called "old" if they were preceded by a matching as opposed to a non-matching context word in the *aware* condition. In this case, the fluency experienced when seeing a matching test and context word was discounted because the familiarity was attributed to having just seen the context word. On the other hand, in the un*aware* condition, test words were more likely to be called "old" when they were preceded by a matching (as opposed to a non-matching) context word. In this instance, participants had lesser time to consciously register the match between the test and context word and thus, did not discount the fluency experienced. Similarly, participants in my study could have discounted the fluency for the repeated items at Time 2 because they could have attributed this feeling of familiarity to the fact that they had just encountered them at Time 1. This recognition was likely enhanced by the short interval between the first and the second part of the study.

On the other hand, Hawkins and Hoch (1992) speculated that the technical nature and specificity of statements could be a possible reason for the absence of a truth effect. In a preliminary study conducted by the authors, the failure to replicate the truth effect was

attributed to some of the study items being too specific or referring to obscure brands (consumer-related trivia claims were used in this study). They speculated that the novel nature of some of these claims and the lack of prior knowledge for these novel claims among participants could have hindered the encoding of statements into memory. This would in turn inhibit the feeling of familiarity when these statements are encountered again at Time 2, thus, resulting in the absence of a truth effect. Some of the climate change statements used in this study referred to specific details (e.g., "The West Antarctic ice sheet is losing billions of tonnes (1 ton= 1000kg) of ice every year, making it a major contributor to global sea level rise" or "Earth's atmosphere now has about 45% more carbon dioxide (CO_2) than it did before the industrial revolution"). This speculation by Hawkins and Hoch (1992) however, might not be directly applicable to the current study given that a truth effect was still observed when comparing repeated and new climate change statements (see below).

Comparison of Mean Truth Ratings between Repeated and New statements

As mentioned previously, the interval between the first rating and the second rating was relatively short in the current study. Although this appeared to have inhibited the presence of an illusory truth effect when comparing statements between Time 1 and Time 2 (discussed above), a truth effect was still observed when comparing repeated and new statements. Specifically, repeated statements were found to be rated higher in terms of truth compared to new statements. This finding is congruent with past studies on the illusory truth effect (Arkes et al., 1989; Bacon, 1979; Begg et al., 1985; Dechene et al., 2009; Fazio et al., 2015; Gigerenzer, 1984; Hasher et al., 1977; Schwartz, 1982). In particular, this finding supports that of Schwartz (1982) who also used a short interval between sessions. In this study, Schwartz (1982) examined whether the truth effect would occur within the same session where truth ratings were separated only minutes apart (i.e., 4 minutes). In part one of the study, participants were shown a set of trivia statements, critical test items were mixed

with filler items. To ensure that these statements were encoded in the memory, participants were asked to read and remember them for a later memory test. This was followed by a cued recall test for filler items, following which one group of participants rated statements for pre-experimental familiarity and the other group rated statements for truth value. Despite the short interval, repeated statements were rated significantly higher than non-repeated statements in the truth rating condition.

Likewise, Fazio et al. (2015) asked participants to rate a set of true or false statements (known, unknown) for subjective interest in the first phase of the experiment. Known statements in this study referred to statements that have an obvious true or false answer (i.e., answered correctly by 60% of norming participants) while unknown statements were answered correctly by only 5% of norming participants. Immediately following this, participants provided truth ratings for both repeated and new statements. An illusory truth effect was found whereby repeated statements (M = 3.53 on a 6-point scale) received higher truth ratings than new statements[22] (M = 3.26). The current study however, differed from both the aforementioned studies. Unlike Schwartz (1982) who required participants to memorize the meaning of statements for a later recall test and Fazio et al. (2015) who asked participants to rate statements on subjective interest, the present study (as with several past studies) asked participants to provide truth ratings at Time 1.

By contrast, Nadarevic and Erdfelder (2014, Experiment 1) failed to find a significant difference in the truth ratings between repeated and new statements (M = 3.58 vs. 3.59) for a short interval (i.e., 10 minutes) despite using a similar design to my study whereby participants provided truth ratings at Time 1. They attributed this null finding to decision inertia (mentioned above). According to this explanation, a large proportion of statements should be rated consistently between the first and second sessions due to the short interval.

[22] Analysis was limited to known and unknown *false* statements.

Moreover, a truth effect should not be observed for *consistently* rated statements compared to new statements. However, a truth effect should be observed for *inconsistently* rated statements compared to new statements. In line with these predictions, Nadarevic and Erdfelder (2014) found a high proportion of statements to have received the same rating across the two sessions. In addition, *consistently* rated statements received comparable ratings to new statements (M = 3.58 vs. 3.55) (i.e., no truth effect). In contrast, *inconsistently* rated statements received significantly lower truth ratings than new statements (M = 3.41 vs. 3.55). Given the negative truth effect observed in the latter case, the authors concluded that decision inertia due to the short interval could not account for the lack of a significant finding between repeated and new statements.

Interestingly though, Nadarevic and Erdfelder (2014, Experiment 2) found a truth effect for the 10-minute interval when they manipulated the type of processing task at Time 1. Attempting to examine if it was the task type at Time 1 that resulted in a null finding in the validity rating condition[23], participants in this study were assigned to either the category-rating condition or the validity rating condition. In the first part of the study, participants in the category-rating condition assigned statements to different knowledge categories (e.g., Geography, Biology etc.) while those in the validity rating condition provided truth ratings. Following a 10-minute interval, participants in both conditions were asked to provide truth ratings for statements. A truth effect was found for the 10-minute interval only in the category-rating condition (i.e., repeated statements had higher truth ratings compared to new statements). This led Nadarevic and Erdfelder (2014) to conclude that although a short

[23] This was done to replicate Schwartz (1982) study whereby a truth effect was found for a short interval using a different task type.

interval does not inhibit the truth effect, a validity rating task at Time 1 is crucial for the absence of a truth effect following a short interval.

These findings are interesting for several reasons. While there is evidence that a truth effect occurs irrespective of a short interval between sessions, this seems to vary depending on the type of task at Time 1. Although Nadarevic and Erdfelder (2014) study findings suggest that providing validity rating at Time 1 inhibits the truth effect, the findings from my study suggests otherwise. In my study, truth rating at Time 1 still resulted in a truth effect despite the short interval, although this was limited to the comparison between repeated and new statements. The next section looks at the results in relation to the cumulative effect of both repetition and photographs on truth ratings.

Cumulative Effect of Fluency Manipulations on Mean Truth Ratings

One of the main aims of the study was to examine the cumulative effect of fluency manipulations, namely the effect of photographs and repetition on the truth ratings of climate change statements. In order to examine this, the mean truth ratings of repeated statements that had been previously paired with photographs at Time 1 (i.e., the effect of both repetition and photographs) was compared with the truth ratings of repeated statements that had previously not been paired with photographs (i.e., the effect of repetition only). If fluency manipulations had a cumulative effect, the fluency driven by the pairing of photographs at Time 1 should have resulted in repeated statements that had previously been paired with photographs to receive higher truth ratings than repeated statements that had not been previously paired with photographs. However, no significant difference in truth ratings was found between the two groups of statements. To the best of our knowledge, the effect of two different fluency manipulations, particularly the use of photographs and repetition within the same experiment, has not been examined before.

Unkelbach (2007) however, conducted a similar experiment whereby colour contrast was manipulated in the learning phase of the experiment and the repeated and new status of statements (i.e., repetition) in the test phase. Participants were initially presented with a set of 60 statements for a brief time during the presentation phase. This was then followed by a learning phase in which individuals were assigned to either the classic condition or the reversed condition and provided truth ratings. Fluency in the learning phase was manipulated through colour contrast (i.e., high, low). Thus, in the classic condition, all high-contrast statements were true and all low-contrast statements were false. In the reversed condition, all high-contrast statements were false and all low-contrast statements were true. Participants then proceeded to the test phase whereby they provided a binary ("yes, true"/ "no, false") response to repeated (from the learning phase) and new statements. Overall, participants in the classic condition responded "yes, true" more often to repeated statements than new statements, with those in the reversed condition responding "yes, true" more often to new compared to repeated statements (Unkelbach, 2007). Despite using two different fluency manipulations, a truth effect was found for both phases of the study.

It is important to note though that the aim of Unkelbach's (2007) study differed slightly from that of the current study. Unkelbach (2007) attempted to show that the association learnt between colour contrast and true/false status of statements can influence the response pattern at test whereby a different fluency manipulation was used (i.e., repetition). Hence, participants who learnt that high/low colour contrast equals true/false respectively in the *classic* condition also rated repeated statements more true than new statements. This is because repeated statements are believed to be processed more fluently than new statements (i.e., higher processing fluency was learnt to positively correlate with true statements). Although the current study did not find any support for the cumulative effect of fluency manipulations, it would be interesting to explore as in Unkelbach's (2007) study if

learning the association that the presence of photographs equals high fluency and no photographs equals low fluency would translate into participants rating repeated statements as more true than new statements.

The previous sections looked at the current study findings in relation to past studies. However, these results should be considered in light of the limitations associated with this study. The limitations that will be addressed in the following section includes the absence of measures assessing pre-experimental knowledge, values and worldviews in relation to climate change, familiarity with certain aspects of climate change, time allocated to complete the study, a short interval between sessions, not including buffer items and a recognition measure for statements.

Limitations and Recommendations based on Study Findings

Absence of measures examining climate change knowledge, values, and worldviews. A majority of the past studies examining the illusory truth effect and the truthiness effect have used trivia statements for which individuals have limited or no background knowledge, as this has been shown to facilitate their reliance on heuristic cues when providing truth ratings (e.g., Newman et al., 2012). Given the inconclusive evidence regarding the effect of pre-existing knowledge on truth judgements, the current study attempted to examine if the illusory truth effect and the truthiness effect would still be observed for claims for which individuals had some knowledge (i.e., climate change statements). As mentioned above, climate change is a salient topic for which most individuals possess some level of knowledge. While there is some evidence to indicate that the use of repetition had some effect on climate change statements, the influence of photographs on truth ratings was minimal. This could possibly be due to climate change opinions and knowledge being heavily influenced by factors such as political affiliations, personal values, and world views. These factors were not examined in the current study. Future research can

examine these factors and the extent to which they moderate the influence of fluency manipulations on truth judgements. This is important as not all types of statements are likely to be influenced by fluency manipulations in the same way.

Familiarity with certain aspects of climate change. Certain aspects of climate change are also more likely to be familiar to individuals. Studies such as O'Neill and Nicholson-Cole (2009) and O'Neill (2019) have found certain aspects of climate change and its impacts to dominate the media space in the U.K. and the U.S. These include topics such as melting glaciers, rise in sea levels, and intense heat and droughts. The greater awareness of certain aspects of climate change more than the others might influence the way in which fluency manipulations affect the truth ratings. For example, an individual who is more aware of the topic of melting glaciers may be more likely to be influenced by the presence of photographs when providing truth ratings because it primes relevant information or less likely to use it because the photograph does not contribute any more information than what is already known to the participant. Thus, it might be helpful to be aware of the level of familiarity of climate change and its impacts in a certain sample. This could be done by asking participants to rate their familiarity on the various aspects of climate change and its impacts (e.g.., melting glaciers).

Time allocated for the task. One other limitation identified was the time allocated to complete the task. Based on previous literature and the discussion above, differences in intervals between sessions (Arkes et al., 1989; Bacon, 1979; Begg & Armour, 1991; Brown & Nix, 1996; Fazio et al., 2015; Gigerenzer, 1984; Nadarevic & Erdfelder, 2014; Schwartz, 1982) as well as the presentation time of statements (e.g., the time each person is given to respond to a statement) within the sessions (Gigerenzer, 1984; Mangus, 2018) have yielded mixed evidence. Although, the current study did not examine the effect of time on truth ratings, Prolific Academic required a maximum time limit to be set for participants. Based on

the pilot study, an approximate of 20 to 40 minutes was deemed sufficient for the completion of the study. Prolific provides a grace period for participants to complete the questionnaire which resulted in a maximum time limit of 67 minutes. While the average response time for participants was approximately 20 minutes, it is possible that participants may have overlooked or paid less attention to the photographs given the time limit. This could have led to the null finding for the effect of photographs. In order to reduce the effect of time variance on truth judgements, a standardized time limit including a fixed exposure time for which individuals would be allowed to view and respond to a statement could be set.

Interval between sessions. Related to the above point is the interval between the first and second part of the study. In the current study, participants proceeded to complete the second portion of the study immediately after finishing the first part. Studies have generally shown the illusory truth effect to be robust against different time intervals (e.g., Arkes et al., 1989; Fazio et al., 2015; Schwartz, 1982), with some even indicating that shorter intervals facilitate the recognition of a statement as repeated which in turn, enhances the truth effect (Schwartz, 1982). However, there is a high likelihood that the immediate transition to the second part of the study may have resulted in participants recognizing many statements as having been presented in the first part and may have chosen to repeat it (i.e., decision inertia). In order to reduce the tendency to repeat ratings and to accurately gauge the effect of fluency manipulations, a longer time interval between sessions might be necessary. While some studies separate subsequent sessions by longer time intervals (e.g., Arkes et al., 1991) to reduce source recollection, others have tended to incorporate a buffer or unrelated task (e.g., solving a puzzle) between sessions (e.g., Nadarevic & Erdfelder, 2014). Thus, despite the robustness of the truth effect, a sufficiently adequate interval between sessions might be necessary.

Lack of buffer items. Seventy-two climate change statements were presented in the first part of this study followed by another 72 items in the second part. Some studies have included buffer items at the beginning and at the end of the session to reduce primacy and recency effects (Bacon, 1979; Hasher et al., 1977; Nadarevic & Erdfelder, 2014). This was not done in the current study given that the addition of buffer items to the current questionnaire which was quite long (a total of 144 items excluding attention checks and free-response questions) together with the short interval between sessions would likely increase fatigue and subsequently affect truth ratings. In order to accurately gauge the effect of fluency manipulations on truth ratings, it might be crucial to include such buffer items in future studies. However, to alleviate the tendency for truth ratings to be affected by fatigue, sessions can be separated by longer intervals.

Including a recognition measure. Lastly, recognition was not measured in this study. The recognition of a statement as repeated or not as opposed to its actual repetition status has been shown to be more influential in observing the illusory truth effect (Bacon, 1979). Collecting a measure of recognition will allow us to see if individuals were more likely to provide higher truth ratings to statements that were judged to be repeated than those that were not; this would provide support for the importance of recognition in the truth effect. In addition, it would also help clarify if it was the higher recognition of statements as repeated at Time 2 that possibly resulted in the lack of significant finding in the first part of the illusory truth effect (i.e., comparing Time 1 and Time 2 statements).

A recognition measure can also be included to ask participants to identify if a statement had previously been paired with a photograph or not. Past studies such as McCabe and Castel (2008) have shown images to increase the perception of accuracy and belief in the information they are paired with. Although the presence of photographs was not found to have an effect on truth ratings in the current study, it would have been interesting to see if

participants were nevertheless aware of the statements that were previously paired with photographs. This would help to clarify if participants failed to process the presence of photographs because of the time limit or had seen them but were not influenced by them when providing the truth ratings.

Having addressed some of the limitations in the current study and the recommendations to address them, the next section looks at the findings from the exploratory analyses and the associated limitations and recommendations.

Recommendations Based on the Exploratory Analyses

Two exploratory analyses were conducted in the previous chapter to examine if the effect of repetition and photographs varied according to the truth status of climate change statements. In examining the effect of repetition on truth ratings, significant main effects were found for both repetition and the truth status of statements. Repeated statements received higher truth ratings compared to new statements and true statements were rated higher in terms of truth than false statements. An interaction effect between repetition and truth status was however, not found. Thus, both repeated and new true statements were equally likely to be rated higher than repeated and new false statements. Similar results were found by Hasher et al. (1977) who asked participants to provide validity ratings to a set of statements on several topics such as history and sports on three occasions interspersed by a two-week interval. Similar to the findings from the exploratory analysis, repeated statements were rated truer than non-repeated statements and true statements were assigned higher truth ratings than false statements. Furthermore, no interaction effect was observed in Hasher et al's. (1977) study. Nadarevic and Erdfelder (2014) also found similar results.

Likewise, the second exploratory analysis looked at the interaction between the presence of photographs and the truth status of statements. Similar to the previous analysis, a significant main effect was found for the truth status of statements whereby true statements

were rated higher in terms of truth than false statements, however, a main effect was not found for photographs. Nevertheless, an interaction effect was observed between the presence of photographs and the truth status of statements; the presence of photographs resulted in true statements being rated as more true and false statements to be rated as more false. The difference in truth ratings between true and false statements have not been routinely examined in studies involving the truthiness effect. Thus, these results require further validation.

Hence, there appears to be some evidence for the effect of fluency manipulations to vary according to the truth status of statements. Some studies have speculated that the tendency to rate true statements as more true than false statements as an indication that participants may have had some pre-existing knowledge that helped them differentiate true statements from false statements (Hasher et al., 1977; Nadarevic & Erdfelder, 2014). Although true and false climate change statements used in the current study were pre-tested for ambiguity, they were not counterbalanced. For example, the statement "Warming waters cause corals to bleach" was not counter-balanced with the statement "Warming waters do not cause corals to bleach". Studies such as Mangus (2018) indicated the importance of counter-balancing statements given that doing so ensured that the statements themselves do not have an effect on truth judgements. This would in turn help to ensure that the truth ratings were influenced by the fluency manipulation. Thus, future studies aiming to use climate change statements could look at counter-balancing these claims.

Conclusions

The current study examined the individual as well as the cumulative effect of repetition and non-probative photographs on truth judgements of climate change statements. To our knowledge, this is one of the first studies to look at these effects in relation to climate change statements. Contrary to past studies, no support was found for the truthiness effect;

the presence of photographs did not significantly influence individuals to rate these statements as truer than their no photograph counterparts. However, partial support was found for the illusory truth effect. Although repeated statements were rated significantly higher in terms of truth ratings than new statements, no difference in truth ratings was found between Time 1 and Time 2 statements. In addition, no support was found for the cumulative effect of both repetition and non-probative photographs on truth ratings. These findings are notable for several reasons.

Firstly, a significant finding for only one part of the illusory truth effect is interesting. Bacon (1979) posited that the truth effect depends on subjects' judgement of the fact that a statement is repeated (i.e., recognition) rather than its actual repetition status. The fact that repeated statements were rated truer than new statements suggests that, on some level, participants had recognized and processed repeated statements more fluently than new statements. This, however did not translate into higher truth ratings for Time 2 statements as compared to Time 1 statements. While it is possible that the short interval between sessions could partly account for this non-significant finding, it is also possible that the difference in ease of processing might have been greater for the repeated and new statements compared to Time 1 and Time 2 statements. This might have resulted in a truth effect for the former rather than the latter.

Secondly, studies on both the illusory truth effect and the truthiness effect have predominantly used trivia statements given their ambiguous nature. Despite inconclusive evidence for the role of pre-existing knowledge in both these areas of study, it is interesting that truth ratings on climate change statements were influenced by repetition but not by the presence of photographs. The presence of an illusory truth effect in spite of using a different type of statement and a short interval further adds credence to the robustness of the illusory truth effect. This is further supported by literature which has shown this effect to be present

even in real world phenomenon such as ‘fake news’ (Pennycook et al., 2018). At the same time, it raises the question of whether the influence of photographs is limited to particular types of statements or topics, namely trivia. It is possible that for certain types of topics such as climate change, factors such as pre-existing knowledge, political ideologies and personal values might be more pivotal in influencing truth ratings compared to photographs. If so, it is important for future research on the truthiness effect to examine the influence of photographs on value and affect-laden topics such as political issues, housing, or poverty which have greater relevance to everyday life. This would in turn, help to clarify the boundary conditions for the truthiness effect.

Thirdly, both the illusory truth effect and the truthiness effect result from the use of processing fluency as a heuristic cue, which in turn informs truth judgments. The discrepancy in fluency rather than the absolute fluency has been shown to result in these effects (Dechêne et al., 2009, 2010; Whittlesea & Williams, 1998, 2000). The use of fluency as a rule-of-thumb for truth has ecological validity given that the positive association between fluency and truth is constantly reinforced in everyday interactions (Reber & Unkelbach, 2010; Tversky & Kahneman, 1974; Unkelbach, 2007). However, it is interesting that these heuristic cues exert their influence even on topics such as climate change which are of importance and relevance to individuals, given that individuals would be expected to rely on their own knowledge and memory in such instances.

Overall, results from the current study seem to suggest the wider applicability of the use of repetition as opposed to the use of photographs in influencing truth judgements. However, this is speculative given that research on the truthiness effect is a relatively new area compared to the illusory truth effect. Moreover, it emphasizes the need to extend research in these two areas to other types of statements including climate change statements so as to have a greater understanding on how heuristic cues are used in processing

information that are of greater relevance to everyday situations. Given that this was one of the first studies to examine the effect of repetition and non-probative photographs on truth ratings of climate change statements, further research is still required to validate some of these findings. It is also crucial for future research to identify conditions under which both the illusory truth effect and truthiness effect do not replicate, given that this area has been relatively under-researched (e.g., Nadarevic & Erdfelder, 2014).

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List of Appendices

Appendix A: Ethics Approval Letter

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

Date: 01 November 2019

Dear Vathsala Sagayadevan

Re: Ethics Notification - **SOB 19/50 - Exploring factors that influence judgements of climate change statements**

Thank you for the above application that was considered by the Massey University Human Ethics Committee: **Human Ethics Southern B Committee** at their meeting held on **Friday, 1 November,**

Approval is for three years. If this project has not been completed within three years from the date of this letter, reapproval must be requested.

If the nature, content, location, procedures or personnel of your approved application change, please advise the Secretary of the Committee.

Yours sincerely

Professor Craig Johnson
Chair, Human Ethics Chairs' Committee and Director (Research Ethics)

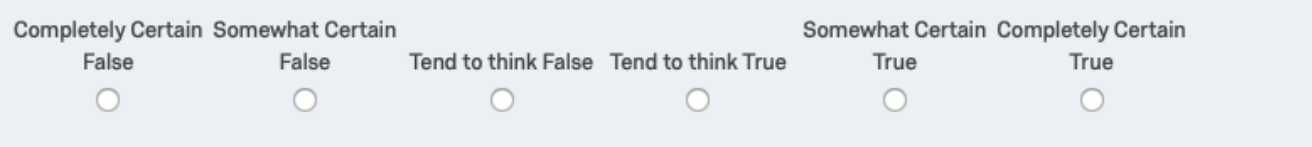
Research Ethics Office, Research and Enterprise
Massey University, Private Bag 11 222, Palmerston North, 4442, New Zealand T 06 350 5573; 06 350 5575 F 06 355 7973
E humanethics@massey.ac.nz W http://humanethics.massey.ac.nz

Appendix B: Study Questionnaire

Exploring factors that influence judgements of climate change statements

Part 1:

This study is divided into 2 parts. For this first part of the questionnaire, please indicate the extent to which you think the following statements are TRUE/FALSE. Answer the questions as quickly as possible but not so quickly that you start making mistakes. Half of these statements will appear with photos while the other half will appear without photos.
Please answer the following questions from your own knowledge and refrain from searching for the answers online.



The above scale (1=Completely certain false, 6=Completely certain true) will be presented with every statement. All statements in Part 1 and Part 2 of the questionnaire will be randomized.

Statements 1-36 will not appear with photos.

True Statements

1. The warming trend measured by thermometers and satellites, is the same in rural and urban areas.
2. Global temperatures are currently the highest since records began.
3. The atmosphere now holds 4% more water vapour than it did 40 years ago as a result of increasing temperatures.
4. Greenhouse gases absorb thermal infra-red radiation emitted by the Earth's surface, causing the planet to warm.
5. Climate scientists and economists predict there will be positive as well as negative effects from human-caused global warming.
6. The planet as a whole is becoming less reflective and absorbing more sunlight which is accelerating global warming.
7. The current sea ice extent is the lowest in the past several thousand years.
8. 2016 was the first year in modern records where surface carbon dioxide (CO2) stayed above 400ppm for the entire year.

9. The amount of carbon dioxide (CO2) absorbed by the upper layer of the oceans is increasing by about 2 billion tons (1 ton=1000kg) per year.
10. Antarctica is gaining sea ice but losing land ice at an accelerating rate.
11. The sun has shown a slight cooling trend in the last 35 years.
12. ‘El Nino' refers to a change in the sea surface temperature across the Tropical Pacific ocean which is linked to a weakening of the usual easterly trade winds.
13. Rising levels of carbon dioxide (CO2) increases atmospheric water vapour which makes global warming much worse.
14. Most of the warming occurred in the past 35 years.
15. Sea levels around the world have risen nearly 20cm (0.7 ft) in the last 120 years.
16. Vegetarians have a reduced carbon footprint.
17. Antarctic lost about 127 billion tons (1 ton= 1000kg) of ice per year between 1993 and 2016.
18. Capitalism increases human involvement in climate change.

False Statements

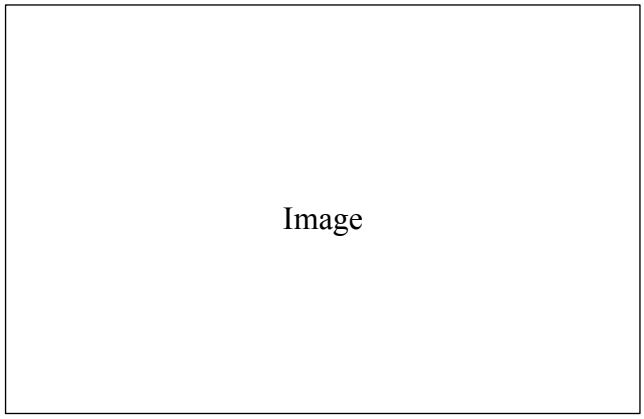
19. The decline in ozone layer in the recent decades is causing global warming.
20. Global temperatures have increased at a greater rate in the past.
21. Climate change models do not reliably reproduce temperatures from the past.
22. The Earth is expected to warm 18°F (10°C) by the end of the century.
23. Changes in evaporation cause global warming.
24. Climate changes are part of a predictable, natural cycle that returns roughly every 11,500 years.
25. Most scientists believe that radon is the main element that causes atmospheric temperatures to rise.
26. The world’s surface temperature has increased nearly 5.4°F (3°C) in the last 140 years.
27. Water vapour is not a greenhouse gas.
28. Carbon dioxide (CO2) increases the rate at which heat is released into space.
29. Mainstream climate models are not able to accurately project global surface temperature changes.
30. Burying lead in the ocean can enhance natural carbon storage systems by absorbing excess carbon.
31. Global warming is part of a 1500-year natural cycle of global temperature variation.
32. The globe is warming because there is more sunlight coming through the ozone hole.

33. Earth has not warmed as much as expected.
34. The rise of global average temperature is due to the urbanization of land around weather stations.
35. The amount of carbon dioxide (CO2) in the atmosphere has been at the current level for 800,000 years.
36. Multiple studies show that the temperature in the 20th century is very similar to that of the last 1000 years.

Statements 37-72 will appear with photos.

True Statements

37. The oceans have absorbed much of the increased heat from the atmosphere.



38. The Arctic ocean is expected to become ice free in summer before mid-century (approx 2050).
39. Melting ice is warming the Arctic.
40. Past temperatures reconstructed using tree-rings, ice cores, and coral shows that the global temperature gradually cooled over the last 1000 years with a sharp upturn in the 20th Century.
41. The rate of carbon uptake from the atmosphere by the ocean has more than doubled since the 1960s.
42. Higher levels of carbon dioxide (CO2) and warmer temperatures will promote vegetation growth in regions where water and nutrients are not limited.
43. Raising the temperature of the Arctic tundra will release methane.
44. Aerosols have a cooling effect on Earth's climate.
45. Warming waters cause corals to bleach.
46. Atmospheric carbon dioxide (CO2) concentrations are currently higher than they have been for at least 800,000 years.
47. 2015, 2016, 2017 are three of the warmest years on record.

48. The West Antarctic ice sheet is losing billions of tonnes (1 ton= 1000kg) of ice every year, making it a major contributor to global sea level rise.
49. Flowers such as snowdrops are blooming earlier in the spring due to climate change.
50. Tiny creatures called pteropods located at the base of many oceanic food chains can be seriously impacted by ocean acidification.
51. Earth's atmosphere now has about 45% more carbon dioxide (CO2) than it did before the industrial revolution.
52. Rising sea levels turn fertile soils into salty infertile soils.
53. Urban heat has had minimal effect on the climate record.
54. Satellite observations reveal that the amount of spring snow cover in the Northern Hemisphere has decreased over the past five decades (50 years).

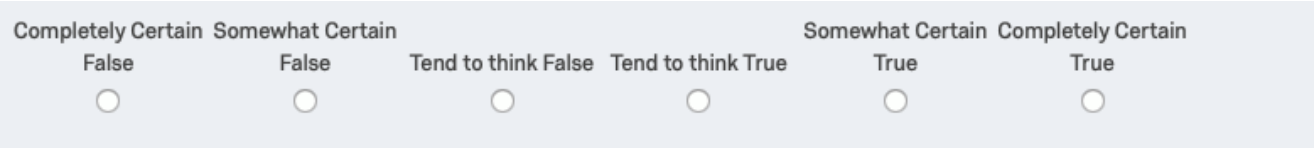
False Statements

55. The planet as a whole is becoming more reflective and reflecting more sunlight.
56. Planting trees is sufficient to reverse climate change.
57. The golden toad was the first species to have gone extinct due to climate change.
58. Stomatal data from plants are more reliable measurements of atmospheric carbon dioxide (CO2) than ice core measurements.
59. Chlorofluorocarbons (CFCs) are the main contributor of global warming.
60. Changes in ocean heat content are a poor reflection of climate changes compared to atmospheric or surface air temperatures.
61. The warming of the planet is due to heat being released from the oceans into the atmosphere.
62. Changes in the sun's energy output has caused the climate to change in the recent years.
63. Winter snow cover in 2008/2009 was at a record high.
64. Planetary movements influence the Earth's surface temperature.
65. Animal agriculture is responsible for majority of human-caused greenhouse gas emissions globally.
66. Volcanic eruptions impose a short term warming influence of several years on the planet.
67. Current Arctic sea ice decline is similar to Arctic sea ice loss in the 1940s.
68. Carbon dioxide (CO2) is a minor greenhouse gas.
69. Arctic sea ice loss is matched by Antarctic sea ice gain.

70. According to multiple satellite and on the ground field measurements, Greenland on the whole is gaining ice.
71. Incidence of mass coral bleaching has decreased dramatically in the last few decades.
72. As snow cover declines, the planet absorbs more solar energy, slowing down global warming.

Part 2:

Please indicate the extent to which you think the following statements are TRUE/FALSE. Answer the questions as quickly as possible but not so quickly that you start making mistakes. Some of the statements are repeated while the rest are new.
Please answer the following questions from your own knowledge and refrain from searching for the answers online.



The above scale (1=Completely certain false, 6=Completely certain true) will be presented with every statement.

Repeated and True Statements

1. The oceans have absorbed much of the increased heat from the atmosphere.
2. Melting ice is warming the Arctic.
3. The rate of carbon uptake from the atmosphere by the ocean has more than doubled since the 1960s.
4. Raising the temperature of the Arctic tundra will release methane.
5. Flowers such as snowdrops are blooming earlier in the spring due to climate change.
6. Tiny creatures called pteropods located at the base of many oceanic food chains can be seriously impacted by ocean acidification.
7. Rising sea levels turn fertile soils into salty infertile soils.
8. Urban heat has had minimal effect on the climate record.
9. Satellite observations reveal that the amount of spring snow cover in the Northern Hemisphere has decreased over the past five decades (50 years).
10. The warming trend measured by thermometers and satellites, is the same in rural and urban areas.
11. Global temperatures are currently the highest since records began.
12. Greenhouse gases absorb thermal infra-red radiation emitted by the Earth's surface, causing the planet to warm.

13. 2016 was the first year in modern records where surface carbon dioxide (CO2) stayed above 400ppm for the entire year.
14. The amount of carbon dioxide (CO2) absorbed by the upper layer of the oceans is increasing by about 2 billion tons (1 ton=1000kg) per year.
15. Antarctica is gaining sea ice but losing land ice at an accelerating rate.
16. Most of the warming occurred in the past 35 years.
17. Sea levels around the world have risen nearly 20cm (0.7 ft) in the last 120 years.
18. Vegetarians have a reduced carbon footprint.

Repeated and False Statements

19. Planting trees is sufficient to reverse climate change.
20. The golden toad was the first species to have gone extinct due to climate change.
21. Changes in ocean heat content are a poor reflection of climate changes compared to atmospheric or surface air temperatures.
22. Changes in the sun's energy output has caused the climate to change in the recent years.
23. Winter snow cover in 2008/2009 was at a record high.
24. Planetary movements influence the Earth's surface temperature.
25. Current Arctic sea ice decline is similar to Arctic sea ice loss in the 1940s.
26. Carbon dioxide (CO2) is a minor greenhouse gas.
27. Incidence of mass coral bleaching has decreased dramatically in the last few decades.
28. The decline in ozone layer in the recent decades is causing global warming.
29. Global temperatures have increased at a greater rate in the past.
30. Most scientists believe that radon is the main element that causes atmospheric temperatures to rise.
31. Water vapour is not a greenhouse gas.
32. Carbon dioxide (CO2) increases the rate at which heat is released into space.
33. Mainstream climate models are not able to accurately project global surface temperature changes.
34. Burying lead in the ocean can enhance natural carbon storage systems by absorbing excess carbon.
35. The amount of carbon dioxide (CO2) in the atmosphere has been at the current level for 800,000 years.

36. Multiple studies show that the temperature in the 20th century is very similar to that of the last 1000 years.

New and True Statements

37. Climate change models successfully reproduce global land, air, and ocean temperatures since 1900.
38. Global sea level is currently rising at about 3cm (0.1ft) per decade.
39. Between 25% and 50% of carbon dioxide (CO2) emissions over the industrial period have been absorbed by the world's oceans.
40. Global dimming (a long term reduction of surface solar radiation) is mainly due to aerosols and clouds.
41. Changes in glacier ice are dictated by air temperature changes and precipitation.
42. A rise in the global mean temperature does not imply universal warming.
43. Melting ice increases the flow of freshwater into the North Atlantic ocean, disrupting a system of ocean currents in the Atlantic, causing it to slow down.
44. Rising sea levels are caused both by the ice melting and by the thermal expansion of seawater.
45. Glaciers across the globe are shrinking, threatening water supplies for millions of people.
46. Both the land surface, and the lower 20km of the earth's atmosphere (troposphere) have warmed.
47. The fossil fuel emission numbers are about 100 times greater than the estimated volcanic carbon dioxide (CO2) fluxes.
48. Aerosol emissions have partly offset the warming effect from greenhouse gases.
49. The planet's average surface temperature has risen about 1.62 degrees Farenheit (0.9 degrees celsius) since the late 19th century.
50. Since the beginning of industrial revolution, the acidity of the surface ocean waters has increased by about 30%.
51. There is increasing evidence that hurricanes are getting stronger due to global warming.
52. The world's surface temperature has increased nearly 1.8°F (1°C) in the last 140 years.
53. In 2017, the average atmospheric concentrations of carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) reached record highs.
54. The Arctic is warming twice as fast as the global average.

New and False Statements

55. Satellite data is inconsistent with surface measurements of global carbon dioxide (CO_2) concentration.
56. Global-scale variations in climate are generally much larger than local climate variations.
57. Urban heat has significantly influenced temperature records over the 20th century with rapid growth of urban environments.
58. The Arctic sea ice melts and forms at a similar time each year.
59. The flow of energy outwards from the interior of the Earth influences climate significantly.
60. Sea ice affects sea levels whereas land ice does not.
61. The sun has shown a slight warming trend since 1960.
62. More than 90% of global warming heat goes into increasing the atmospheric and surface air temperatures, while less than 3% goes into warming the oceans.
63. 1934 is the hottest year on record.
64. Deforestation accounts for almost half of all global emissions.
65. Climate change is chaotic and cannot be accurately predicted by climate models.
66. The trace greenhouse gases such as methane (CH_4) have decreased over the years.
67. The current declines in Arctic ice coverage and volume reflects a natural cycle.
68. Emails seized from prominent climate scientists suggest conspiracy and data manipulation.
69. Carbon dioxide (CO_2) emissions have a short residence time in the atmosphere.
70. Most scientists believe that hydrogen is the main element that causes atmospheric temperatures to rise.
71. Carbon dioxide (CO_2) is not an air pollutant.
72. As surface waters become more acidic, it becomes easier for marine life like corals and shellfish to form the hard shells necessary for their survival.

Free-Response questions

3. Did you use any strategies to rate the truth of the statements? If yes, what strategies did you use?
4. Did the presence of photos influence your judgements in any way? If yes, how?

Appendix C: Information Sheet

Exploring factors that influence judgements of climate change statements

INFORMATION SHEET

Introduction

You are invited to take part in an online psychology research study which contributes to a Masters in Science degree in Psychology. This research is a partial fulfilment of the requirements to complete the qualification at the School of Psychology at Massey University, Manawatu Campus (New Zealand). This participant information sheet will help you decide if you would like to take part in this study. It outlines the purpose of the study, what your participation would involve, the risks and benefits associated with the study. Please read through the following information to help you decide if you would like to take part in this study.

Vathsala Sagayadevan (Primary Researcher)

Phone [redacted]
Email [redacted]

Dr Stephen Hill (Supervisor)

Phone (06) 356 9099 ext 7566
Email S.R.Hill@massey.ac.nz

Project Description

In this study, you will be shown a set of climate change statements. Some of the statements will be accompanied by a photo while the others will not; the photo will not provide information about whether the statement is true or false. We are primarily interested in looking at whether you think the displayed statements are true or false based on your general knowledge.

You are invited to take part in this study. As this is an online study, you will be able to participate in this study once you have indicated your consent on the online consent form.

Participant Identification and Recruitment

Approximately 80 participants, aged 18 years and older will be invited to participate in this online study. The number of participants selected has been deemed an appropriate number in order to detect an effect for this particular study.

Participants will be recruited through Prolific Academic, a crowdsourcing platform. In order to participate in this study, it is important to be able to read and understand English. Pre-screening criteria (i.e., English as first language, 18 years and above) will be applied through Prolific Academic to obtain the relevant pool of participants. In recognition of your time and participation in this study, a total of £2.50 will be reimbursed into your Prolific account upon completion of the study.

Project Procedures

This study is divided into three parts:

-During the first part of the study, you will be asked to provide a truth rating (i.e., the extent to which you think a statement is true or false on a 6-point scale) to a set of 72 climate change statements. Half of these statements will appear with photos while the other half will not. Half of these statements will be false whereas the other half will be true.

-In the second part of the study (which will immediately follow the first part), you will be shown another set of 72 climate change statements; half of these statements will be those that have been encountered in the first part of the study while the other half will be new statements. You will once again be asked to provide a truth rating to this set of climate change statements. Half of these statements will be true while the other half will be false. None of the statements will appear with photos.

-Lastly, you will be asked to complete a few open-ended questions and will be directed to the study debrief section once this has been done.

It will take approximately 20-45 minutes to complete the entire study.

Risks and benefits

For the purpose of this study, specific aims of the study will be withheld until the end of the study. Upon completing the study, you will be directed to a debrief section which will explain the specific aims of the study in detail. Participating in this study is completely voluntary and you can decline to participate or withdraw from the research at any time (up till end November). You also have the right to decline to answer any particular question. There is little to no chance of discomfort arising from not knowing the specific aims of the study at the outset. There is no cost to you, the participant, for taking part in this study.

Participant's Rights

Participating in this study is completely voluntary and you can decline to participate or withdraw from the research at any time, without experiencing any disadvantage. As this is an

online questionnaire, completion and return of the questionnaire implies consent. You have the right to decline to answer any particular question.

Data Management and Archiving

It is important to us that we maintain your privacy throughout this study and any information collected will be held electronically and stored on the primary researcher's computer. All data will be recorded against your Prolific ID and will never be used in any report, correspondence or publication. Your involvement in this study is confidential.

Data collected will be aggregated before it is analysed for research purposes, and individual results will not be personally identifiable in the research findings. A de-identified version of your data that cannot be linked to you personally will be permanently stored in an online research data repository (Open Science Framework-OSF).

Ethical approval information

This project has been reviewed and approved by the Massey University Human Ethics Committee: Southern B, Application 19/50. If you have any concerns about the conduct of this research, please contact Dr Rochelle Stewart-Withers, Chair, Massey University Human Ethics Committee: Southern B, telephone 06 356 9099 x 83657, email humanethicsouthb@massey.ac.nz

Project Contacts

The researcher(s) named in this document are responsible for the ethical conduct of this research. If you have any questions about this research, please contact the primary researcher of this project: Vathsala Sagayadevan at [redacted]. You may also contact the project's supervisor: Dr Stephen Hill at S.R.Hill@massey.ac.nz.

Appendix D: Histogram and Q-Q plot for the Difference in Mean Truth Ratings between Statements Paired with Photographs (T136photo) and without Photographs (T136nophoto)

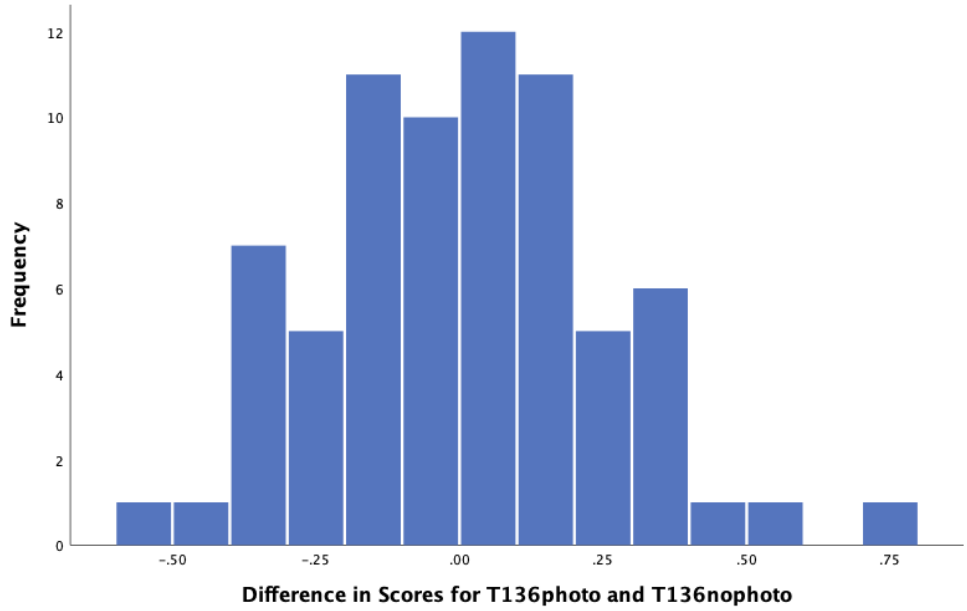


Figure D1. Histogram of difference in mean truth ratings between statements paired with and without photographs.

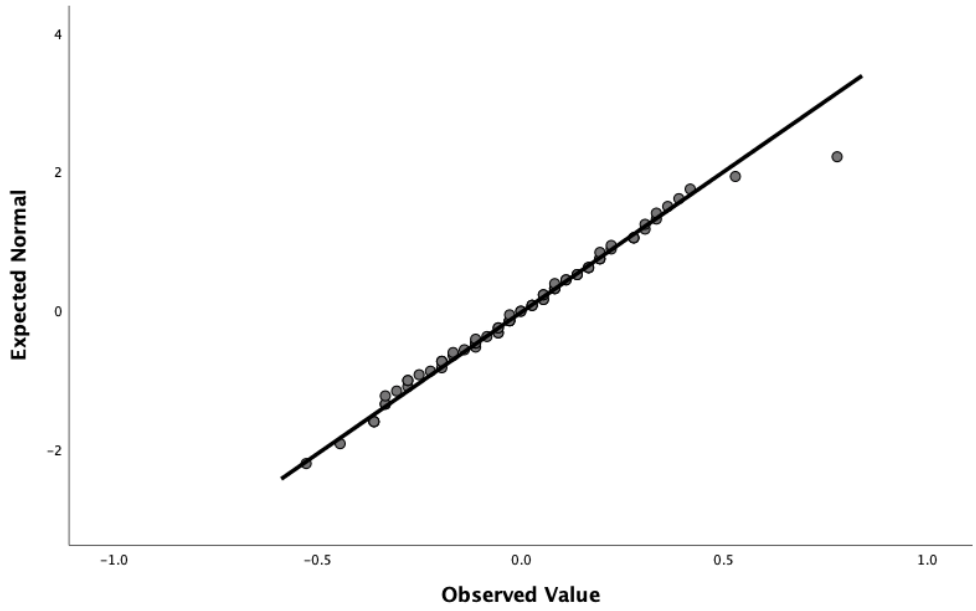


Figure D2. Normal Q-Q plot of difference in mean truth ratings between statements paired with and without photographs.

Appendix E: Histograms and Q-Q Normality Plots of Mean Truth Ratings for T1photo, T1nophoto, T2repeatedphoto, T2repeatednophoto, and T2new

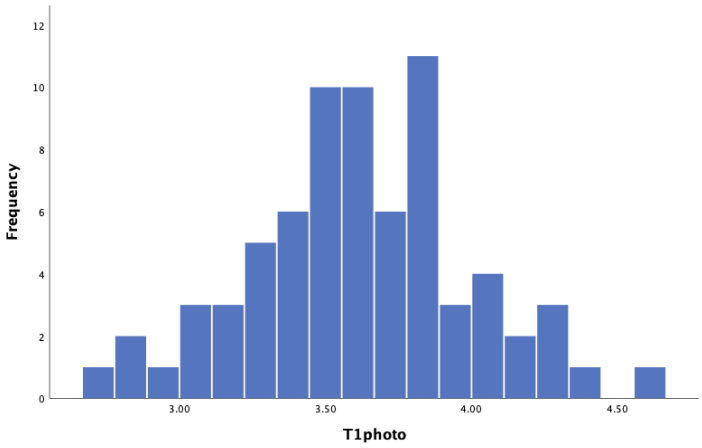


Figure E1. Histogram of mean truth ratings for statement type T1photo.

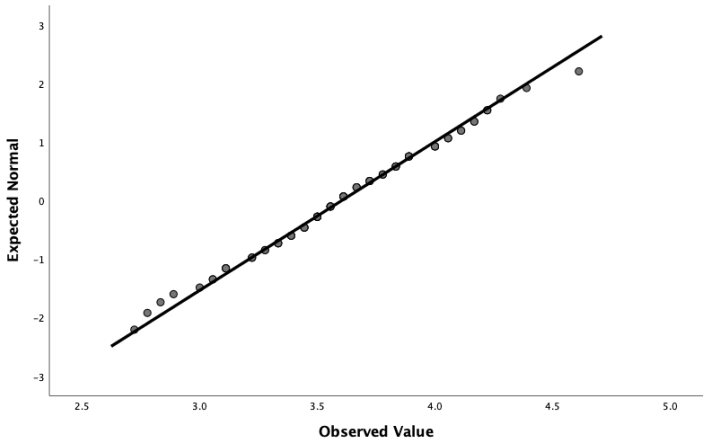


Figure E2. Normal Q-Q plot of mean truth ratings for statement type T1photo.

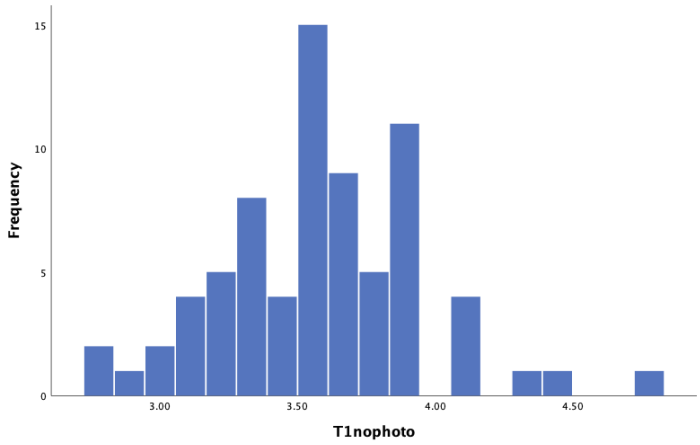


Figure E3. Histogram of mean truth ratings for statement type T1nophoto.

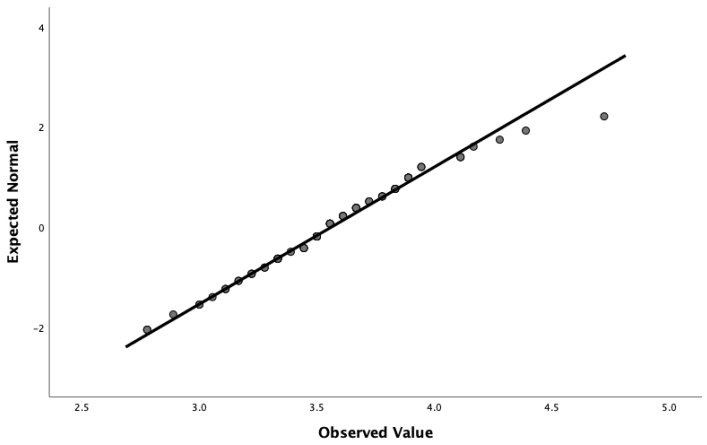


Figure E4. Normal Q-Q plot of mean truth ratings for statement type T1nophoto.

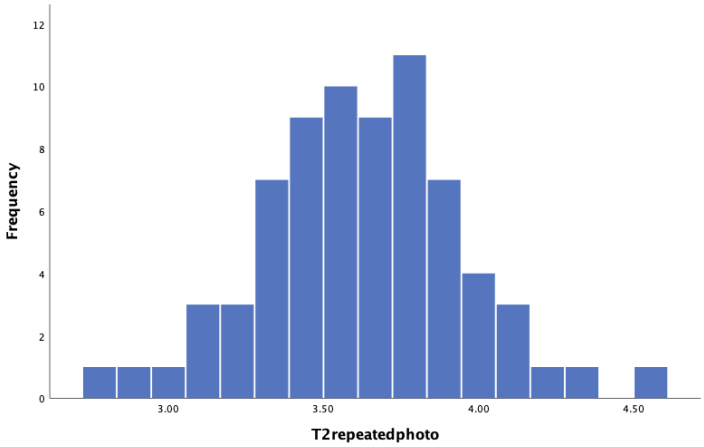


Figure E5. Histogram of mean truth ratings for statement type T2repeatedphoto

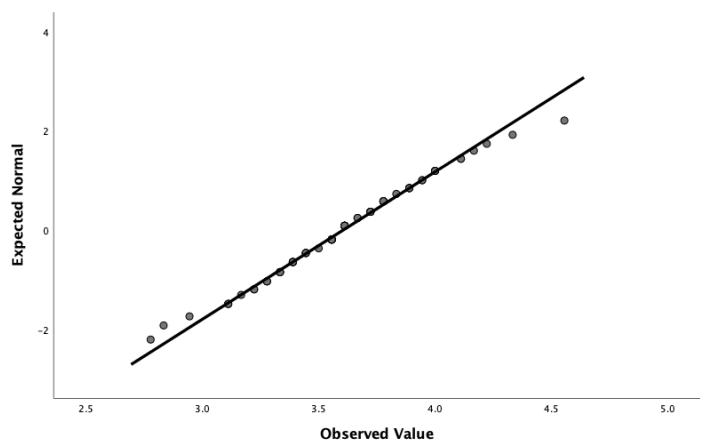


Figure E6. Normal Q-Q plot of mean truth ratings for statement type T2repeatedphoto

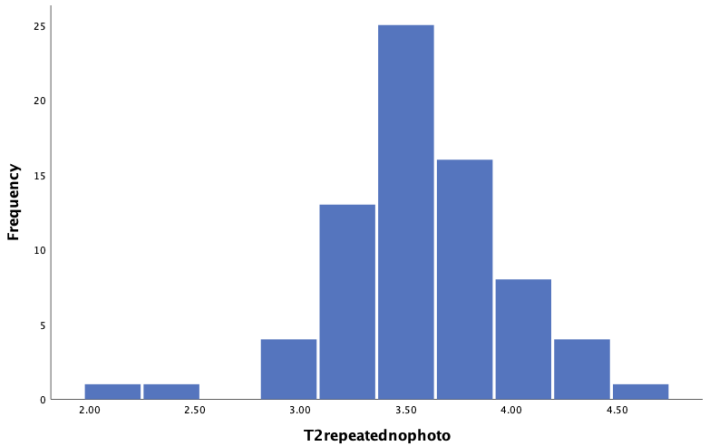


Figure E7. Histogram of mean truth ratings for statement type T2repeatednophoto.

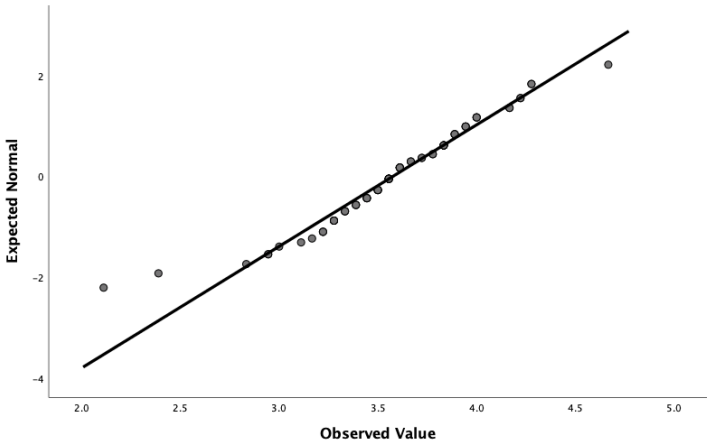


Figure E8. Normal Q-Q plot of mean truth ratings for statement type T2repeatednophoto.

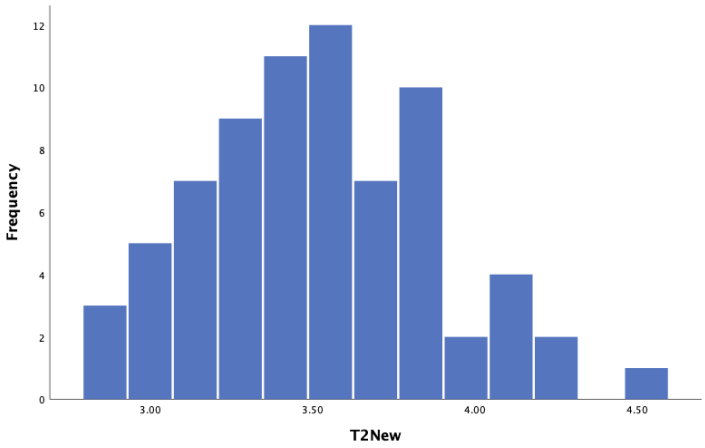


Figure E9. Histogram of mean truth ratings for statement type T2new.

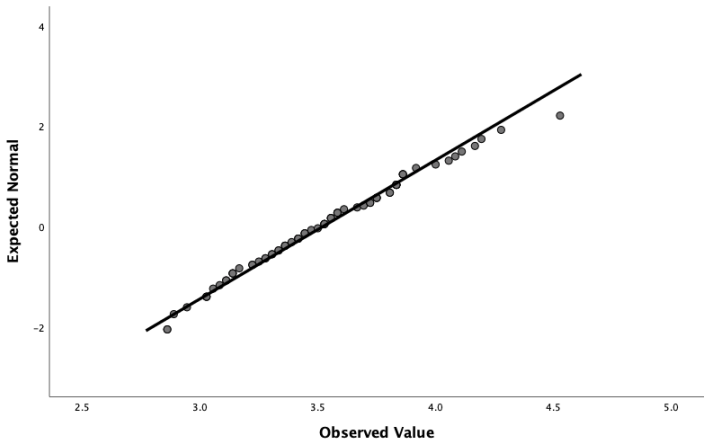


Figure E10. Normal Q-Q plot of mean truth ratings for statement type T2new.