Heuristics for Truth Across the Lifespan

by

Nadia Marie Brashier

Department of Psychology & Neuroscience
Duke University

Date:_______________________
Approved:

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Elizabeth Marsh, Supervisor

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Tobias Egner

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David Rubin

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Gregory Samanez-Larkin

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Gavan Fitzsimons

Dissertation submitted in partial fulfillment of
the requirements for the degree of Doctor
of Philosophy in the Department of
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ABSTRACT

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Abstract

Misleading claims surround us – we encounter them in news stories, advertising campaigns, and political propaganda. How do people separate facts from fiction? Decades of work implicate *fluency*, or subjective ease. Repeated statements feel easier to process, and thus more truthful, than new ones (i.e., *illusory truth*). This dissertation identifies additional cues for truth and takes a lifespan perspective. Older adults accumulate impressive amounts of knowledge (which may protect them), but also unduly attend to positive information (which may leave them vulnerable to emotional appeals). In two experiments, older adults exhibited illusory truth only when they lacked knowledge about claims, unlike young adults. Three additional experiments encouraged young adults to "stick with" what they knew. Evaluating truth at exposure prompted young adults to use their knowledge later, wiping out the illusion. Three final experiments disproved the idea that positivity "feels like" truth. Young adults exhibited a *negativity bias*, where negative faces made claims seem less true than neutral ones. Neither positive nor negative faces swayed older adults' judgments. These results inform many theoretical perspectives – from fluency and referential theories of truth, to dual-process and socioemotional selectivity theories of aging. They also have important practical implications for preventing and correcting misconceptions in a "post-truth world," where falsehoods travel farther and faster than the truth.

Dedication

Für Charlotte Maier *(† 19 January 2018)*, die sich in ihrer dunkelsten Stunde an mein Gesicht erinnerte.

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Acknowledgements

In the spirit of a dissertation about truth, here are a few facts: People like me rarely graduate college (20% of first-generation college students earn a Bachelor's degree vs. 42% of continuing-education students), let alone earn a PhD (3% earn a Masters degree or higher vs. 13% of continuing-education students; U.S. Department of Education, 2017). The only thing that sets me apart are the people who unconditionally support me: my family, friends, and mentors.

I owe an immeasurable debt to my parents, Sabine and Al Brashier. Amid all of your sacrifices, you never doubted that the seeds you planted would yield flowers. Danke Mama, daß Du meinen Traum, Wissenschaftler zu werden, nicht als Möglichkeit, sondern als selbstverständliche Schlussfolgerung behandelt hast. Thank you Papa for teaching me lessons you can't find in books, including how to stand my ground. I am also thankful for my ever-entertaining brother, Nicholas, my kind, selfless partner, AJ Atkinson, and my ride-or-die friends – Nmeli, Karen, Porsche, Savini, Adeyemi, and Chris – who remind me that when it comes to my goals, it's *when* not *if*.

Great mentors walked alongside me and I would not be here without them. Kristi Multhaup showed me this path to begin with; when it seemed to be cut for somebody other than me, she and Julio Ramirez assured me that I could walk it just the same. Beth Marsh treated me as a colleague and encouraged my independence, but most importantly stood fiercely in my corner when it mattered most.

Many thanks to the other members of my committee – Tobias Egner, Gavan Fitzsimons, Greg Samanez-Larkin, and David Rubin – for their thoughtful suggestions, as well as for serving as informal mentors over the years.

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1. Introduction: Heuristics for Truth[1]

Whatever satisfies the soul is truth. – Walt Whitman

Every day, we come across false claims that range from ridiculous (e.g., that spicy foods cause ulcers) to dangerous (e.g., that vaccines cause autism). Discriminating facts from fiction has never been straightforward, but misconceptions become mainstream even more rapidly in the digital age. Many worry that we now live in a "post-truth world" (see Lewandowsky, Ecker, & Cook, 2017), where opinions outweigh facts. Tellingly, Oxford Dictionaries declared "post-truth" their 2016 word of the year. This sentiment belies the public's increasing interest in combating misinformation: Google searches about "fake news" spiked dramatically during the 2016 presidential election. Concomitantly, sites with high-quality journalism saw a "Trump bump" in subscriptions (Newman, Fletcher, Kalogeropoulos, Levy, & Nielsen, 2017) and responded in kind (e.g., The New Yorker's new tagline "fighting fake stories with real ones").

Most people believe that fake news causes "a great deal of" (64%) or "some" (24%) confusion about basic facts. Paradoxically, many also feel very (39%) or somewhat (49%) confident in their own ability to recognize these stories (Pew Research Center, 2016). As consumers seek to control content (by visiting sites they trust), online

[1] Some of these ideas will contribute to Brashier, N. M., & Marsh, E. J. (invited review in preparation). Separating facts from fiction: Heuristics for truth. *Annual Review of Psychology*.

platforms like Google, Facebook, and Twitter have begun testing "trust indicators." Recommendations to consider the source ignore fundamental principles of cognitive science. People may not spontaneously think back to information's original source (e.g., R. Marsh, Landau, & Hicks, 1997). Moreover, it can be tricky to identify poor sources in the first place; even Stanford undergraduates fail to discriminate mainstream from fringe online news sources (Wineburg, McGrew, Breakstone, & Ortega, 2016).

Attempts to limit the spread of misinformation should focus instead on "shortcuts" for truth. When faced with ambiguity and complexity, we keep it simple by falling back on rules of thumb. *Heuristics* minimize time and effort in contexts as varied as locating serial offenders (Snook, Taylor, & Bennell, 2004) and predicting the outcomes of tennis matches (Serwe & Frings, 2006). Despite ignoring part of the information, they often match or exceed the accuracy of statistical methods (i.e., *less-is-more effects*; Gigerenzer & Gaissmaier, 2011). Crucially, our "adaptive toolboxes" include domain-specific heuristics, not general algorithms (Gigerenzer, 2002).

What specific heuristics help us to make "fast and frugal" truth judgments? Some heuristics that perform well in other domains do not logically extend to judging truth. For example, the tendency to cooperate first and then imitate a social partner's last behavior (i.e., *tit-for-tat heuristic*; Axelrod, 1984) facilitates cooperation, but cannot discriminate truths from falsehoods. On the flip side, not all cues for truth generalize, even to other superficially similar judgments (e.g., liking, confidence). Indeed, evaluating truth seems to be distinctive in two ways. First, truth judgments are verifiable; they "can always be seen before the background of an objective value" (Dechêne, Stahl, Hansen, & Wänke, 2010, p. 254). This implies a critical role for knowledge; remembering facts about Ruth Bader Ginsburg (e.g., that she hired a full slate of law clerks through 2020, that she promised to remain on the bench through the Trump presidency) can be enough to reject a headline like *BREAKING: Ruth Ginsburg RESIGNED and she is moving to New Zealand* as false, but may not be sufficient to judge how much you *like* her. Second, people exhibit a general bias to call claims "true." According to Gilbert and colleagues (Gilbert, 1991; Gilbert, Krull, & Malone, 1990; Gilbert, Tafarodi, & Malone, 1993), people automatically assume that a statement is true because "unbelieving" comprises a second, resource-demanding step. The size of this bias is overstated – on average, ambiguous claims seen for the first time are not endorsed as "definitely true" – but it does reliably appear in my own work (across experiments, $M = 0.30$ deviation from the middle of a 6-point scale). Likewise, people assume social partners' honesty, leading to an asymmetry in detection of truths and lies (see Hartwig & Bond, 2011, Bond & DePaulo, 2006, for meta-analyses). Thus, factors broadly implicated in judgment and decision-making (e.g., affect) may shape truth in surprising ways.

1.1 An (Undue) Focus on Fluency

As advertisers and politicians seem to realize, one easily-exploited "shortcut" for truth involves repetition. Repeating claims makes them easy to process, or *fluent*. Fluency serves as a powerful cue for many judgments (see Alter & Oppenheimer, 2009, for a review); it implies liking (Iyengar & Lepper, 2000), confidence (Schwartz & Metcalfe, 1992), fame (Jacoby, Kelley, Brown, & Jasechko, 1989), familiarity (i.e., evidence of past experience; Schwartz, 1982),[2] and social consensus (Weaver, Garcia, Schwarz, & Miller, 2007). Subjective ease also inflates perceived truth: Repeated statements seem truer than new ones (i.e., *illusory truth*; Hasher, Goldstein, & Toppino, 1977). This phenomenon has replicated dozens of times (see Dechêne et al., 2010, for a meta-analysis). Decades of work reveal that the basic effect persists over time (up to months; Brown & Nix, 1996), generalizes across materials ("fake news" headlines; Pennycook, Cannon, & Rand, in preparation; consumer claims, Johar & Roggeveen, 2007; sociopolitical opinions, Arkes, Hackett, & Boehm, 1989), and reflects activity in perirhinal cortex (Wang, Brashier, Wing, Marsh, & Cabeza, 2016). It can even emerge without repetition – statements displayed in high contrast (**The capital of Madagascar is Antananarivo**) seem truer than those in low-contrast (The capital of Madagascar is Antananarivo; Reber & Schwarz, 1999); aphorisms that rhyme (e.g., *What sobriety conceals, alcohol reveals*) feel more accurate than those that do not (e.g., *What sobriety*

[2] Unkelbach (2007) notes that "fluency" connotes an experience, while "familiarity" implies an interpretation of that experience (i.e., the feeling that there is something "about" a stimulus).

conceals, alcohol unmasks; McGlone, & Tofighbakhsh, 2000); and claims paired with pictures appear truer than those presented alone (Newman, Garry, Bernstein, Kantner, & Lindsay, 2012).

Cognitive, social, and consumer psychology converge on fluency's potential to lead us astray – but do other "illusions" of truth exist? The empirical attention devoted to fluency implies that it serves as a single "clever" cue for truth. Some judgments are made for "one good reason" (Gigerenzer & Gaissmaier, 2011). Whether catching a fly ball or pursuing prey, for example, it is optimal to maintain a constant optical angle between your target and yourself; baseball and cricket players (McLeod & Dienes, 1996) use the same *gaze heuristic* as bats, birds, and fish, rather than computing trajectories in three-dimensional space. If fluency served as "one good reason" for truth, it would prove accurate most of the time. Fluency predicts real-world outcomes, such as the profits yielded by stocks (stocks with fluent names outperform those with disfluent names; Alter & Oppenheimer, 2006). It also naturally correlates with truth – we hear the single true version of a statement (e.g., *The capital of Argentina is Buenos Aires*) more frequently than any one of its many possible falsifications (e.g., *The capital of Argentina is La Paz, The capital of Argentina is Lima, The capital of Argentina is Montevideo*). With experience, people learn that relying on fluency typically leads to the correct judgment (Unkelbach, 2007).

Despite its utility, people do not always infer truth from ease. They quickly reverse the direction of the fluency heuristic upon learning that fluent items tend to be false (i.e., Unkelbach, 2007; Scholl, Greifeneder, & Bless, 2014). A re-analysis of 21 experiments showed that recognition speed (a proxy for fluency) only guides inferences about size sometimes (Pohl, Erdfelder, Michalkiewicz, Castela, & Hilbig, 2016). By extension, truth judgments may also be shaped by cues other than fluency.

1.2 Other Paths to Truth

By 2022, Gartner Inc. (an information technology research firm) predicts that we will consume more false than true information. Between 2006 and 2017, falsehoods were 70% more likely to be retweeted than the truth (Vosoughi, Roy, & Aral, 2018). If fluency no longer naturally correlates with truth, what other cues will people use? Multinomial modeling shows that people rely on fluency only if they fail to recollect whether or not a statement came from a credible source (Unkelbach & Stahl, 2009). Unsurprisingly, such failures are frequent – participants mistakenly indicated that 58% of the false statements (spoken by a voice labeled "false" only 30 minutes earlier) were "true." Without recollective encoding (and associated activity in hippocampus and ventrolateral prefrontal cortex) at exposure, claims initially tagged as "false" appear credible later (Mitchell, Dodson, & Schacter, 2005). Along these lines, Henkel and Mattson (2011) found that after a 2-3 week delay, participants exhibited an illusory truth effect for statements that they later attributed (correctly or incorrectly) to an unreliable source.

In daily life, claims rarely appear alongside explicit "true" and "false" tags, leaving people to their own inferences. Getting information from a conversational partner adds even more uncertainty. Not all untruths are lies, as falsehoods can be relayed with the sincere belief that they are true; rather, lies are the most egregious form of falsehoods. While some people tell more convincing lies than others, most of us *detect* lies at a rate barely better than chance (Bond & DePaulo, 2006). Participants report using nonverbal cues (e.g., eye contact; the *deceiver stereotype*) that only weakly correlate with their judgments. The cues that they *do* use – disfluent speech, ambivalence, and the pleasantness of a speaker's face, among others – vary in their validity (Hartwig & Bond, 2011). Interestingly, groups spot liars more accurately than individuals (Klein & Epley, 2015). Given this *wisdom of the crowd*, perhaps it is unsurprising that people weigh opinions equally regardless of individuals' competence (Mahmoodi et al., 2015) and value consensus (Visser & Mirebile, 2004). In egocentric biases, we also overestimate the degree to which our beliefs overlap with other people's (i.e., *false consensus effect*; see Marks & Miller, 1987, for a review) and privilege information that (we believe) is self-generated. After estimating the average lifespans of different countries, for example, participants favor guesses arbitrarily attributed to them over their real guesses (Trouche, Johansson, Hall, & Mercier, 2018).

Most "fake news" circulates on social media (Allcott & Gentzkow, 2017). Biases in our ability to recognize friends who lie or hold uninformed opinions can incur large costs on platforms like Facebook, where content is shared without fact-checking or editorial judgment. While advice to avoid "untrustworthy" sources might be taken to mean that we should read articles published by *The New York Times* and watch CNN, it translates more accurately into completely abstaining from our own timelines.

In sum, source serves as an unreliable cue for truth. If people accurately monitor and retrieve source information (nontrivial assumptions), it can constrain illusory truth (Unkelbach & Stahl, 2009). Until recently, another assumed constraint on fluency was knowledge. Intuitively, it seems improbable that repeatedly contradicting well-known facts (e.g., *A date is a dried plum*) makes people believe them. In fact, a meta-analytic review states that illusory truth only occurs when claims are "ambiguous, that is, participants have to be uncertain about their truth status because otherwise the statements' truthfulness will be judged on the basis of their knowledge" (Dechêne et al., 2010, p. 239). Similarly, Unkelbach and Stahl (2009) tested their multinomial model with obscure materials (knowledge parameter probabilities ranged from .01 to .05), presuming that knowledge eliminates the effect. However, we recently demonstrated that fluency can "trump" knowledge; repeating false statements (e.g., *A date is a dried plum*) increased beliefs in those claims, even when participants "knew better" (e.g., that drying plums produces prunes, not dates). Multinomial modeling confirmed that people sometimes rely on fluency despite having contradictory knowledge stored in memory (Fazio, Brashier, Payne, & Marsh, 2015).

This points to the *trouble with titles* – titles of "fake news" stories bear more resemblance to satire than to actual news headlines (Horne & Adali, 2017). It is no coincidence that *The Onion*'s titles (e.g., *Study Reveals: Babies Are Stupid*, *Drugs Win Drug War*, *Winner Didn't Even Know It Was Pie-Eating Contest*) feel especially apt. Compared to "real" titles (e.g., *Obama Designates Atlantic, Arctic Areas Off-Limits To Offshore Drilling*), "fake" titles run longer, use simpler words, and include more proper nouns and verbs (e.g., *URGENT: The Mainstream Media Was Hiding One HUGE Fact About Trump Win!*). They pack a lot of information, in the hopes that people accept the title (and share the story) without reading further. Even when prodded to evaluate the source of a tweet, less than half of people click on the provided link (Wineburg et al., 2016). If readers do skim the article, they will be biased by the misleading title. Even subtle misinformation in headlines biases our memory for, and inferences about, factual articles and opinion pieces (Ecker, Lewandowsky, Chang, & Pillai, 2014). Repeated shares make such headlines fluent and believable – even if they directly contradict well-known facts – further reinforcing false beliefs.

In the face of fluency, knowledge is *not* always power. Conflicting facts stored in memory do not offset the appeal of easy, fast truth judgments. Interestingly, induced negative mood wipes out illusory truth (Koch & Forgas, 2012) and also helps people to detect deception (Forgas & East, 2008). This follows from the strong link between fluency and affect, evident in both self-report and psychophysiological measures.

Participants who view Chinese ideographs five times report more positive moods than people who see each ideograph once (Monahan, Murphy, & Zajonc, 2000). Fluent experiences literally put a smile on your face – easy-to-process pictures (Winkielman & Cacioppo, 2001) and pseudowords (Carr, Rotteveel, & Winkielman, 2016) elicit brief, positive reactions, indexed by activity in the zygomaticus "smiling" muscle.

Does positivity "stand alone" as a cue for truth, in the absence of fluency? One study hints that this may be true: Perceptions of claims' positivity correlate with truth ratings (Unkelbach, Bayer, Alves, Koch, & Stahl, 2011). Emotions inform a wide range of judgments (see, Forgas, 1995; Greifeneder, Bless, & Pham, 2011; Lerner, Li, Valdesolo, & Kassam, 2015), from risk estimates (Johnson & Tversky, 1983) to judgments of learning (Hourihan & Bursey, 2017). Simply holding a pen between the teeth (facilitating smiling) makes cartoons seem funnier than holding a pen between the lips (preventing smiling; Strack, Martin, & Stepper, 1988). It stands to reason that affect also shapes perceptions of truth, but little empirical work speaks to this point.

Understanding the persuasive power of emotions is particularly important, given the affective qualities of "fake news." These stories spread more quickly than the truth not because of robots (which disseminate true and false news at similar rates), or because people who share "fake news" have more followers (the opposite is true). Instead, they incite different emotions. False stories inspire fear, disgust, and surprise in replies, while true stories evoke anticipation, sadness, joy, and trust (Vosoughi et al., 2018). This feature of misleading headlines certainly makes them provocative, but does not necessarily make them more persuasive; some people (14%) admit to knowingly sharing false news (Pew Research Center, 2016).

1.3 Truth through Older Eyes

In addition to focusing narrowly on fluency, current theories of truth largely ignore change across the lifespan. This presents a thorny problem not only because America is "greying" more rapidly than demographers initially projected – the 65-and-over population will nearly double by 2050 (U.S. Census Bureau, 2014) – but also because exposure to misinformation may increase in old age. By some estimates, older adults consumed the most "fake news" in the month preceding the 2016 election (Guess, Nyhan, & Reifler, 2018). This is especially concerning because they voted at a higher rate (70.9% turnout) than any other age group (e.g., 46.1% turnout among 18- to 29-year-olds, U.S. Census Bureau, 2017). In a similar vein, misleading advertising campaigns (e.g., "anti-aging" products) and scams (e.g., about Social Security) specifically target Baby Boomers, who also control 70% of the nation's disposable income (The Buntin Group). Given older adults' disproportionate political and economic influence, it is troubling that we know so little about how they evaluate truth.

Aging involves cognitive and social changes that bear on cues for truth. Memory for source, for example, tends to decline with age (d = 0.73, see Old & Naveh-Benjamin, 2008, for a meta-analysis). Notably, older adults struggle to remember whether a speaker was male or female, but match young adults' performance when identifying whether a speaker was trustworthy or not (Rahhal, May, & Hasher, 2002). A similar theme emerges in studies of interpersonal deception. Compared to young adults, older adults tell less convincing lies (Ruffman, Murray, Halberstadt, & Vater, 2012) and resort to dishonesty less often in their everyday lives (El Haj & Antoine, 2018). They detect others' deception less accurately than their young counterparts, partly due to decreased recognition of the speaker's emotions (Ruffman et al., 2012; Stanley & Blanchard-Fields, 2008). This "doubt deficit" also reflects a qualitatively different approach to judging trustworthiness. Older adults exhibit "muted" insula activation while viewing facial characteristics usually deemed "untrustworthy," implying that they rely less on "gut feelings" (Castle et al., 2012); these facial cues actually do a poor job of distinguishing liars from truth tellers. Similarly, Slessor and colleagues (2012) asserted that older adults are less able to "extract socially relevant information from the eye region" (p. 183). Actually, older adults appeared to disregard the *deceiver stereotype*, where averted eyes are misinterpreted as evidence of dishonesty. Ironically, the American Association of Retired Persons' (AARP, 2017) first of seven tips for older adults concerned about "fake news" is to *consider the source*. While this may not be *worse* advice for older than young adults, it is not an ideal strategy for either age group.

Fortunately, older adults accumulate massive amounts of general knowledge that may lead them to sound truth judgments. *Fluid intelligence*, including memory for recent events, declines with age, but *crystallized intelligence*, or knowledge, remains intact (see Baltes, Staudinger, & Lindenberger, 1999, Salthouse, 2012, for reviews). Older adults remember most (60-80%) of their college grades (Bahrick, Hall, & Da Costa, 2008) and recognize the majority (90%) of their high-school classmates (Bahrick, Bahrick, & Wittlinger, 1975) decades after graduating. They add to their vocabularies (e.g., Arbuckle, Cooney, Milne, & Melchior, 1994; Bahrick, 1984; Bowles & Poon, 1985; Burke & Peters, 1986; Mitchell, 1989; Perlmutter, 1978) and acquire facts about the world (e.g., Botwinick & Storandt, 1980; McIntyre & Craik, 1987; Perlmutter, 1978) into very old age. This dissertation asks whether decades of knowledge "protect" older adults from the misleading influence of fluency.

On the other hand, changes in older adults' goals and affective processing may leave them vulnerable to emotional appeals. *Socioemotional selectivity theory* (SST; Carstensen, Isaacowitz, & Charles, 1999) posits that *endings* shift people from seeking new information to focusing on what is already emotionally meaningful to them. Behaviorally, this changes people's social preferences; older adults are more likely than young adults to select familiar social partners over new ones (e.g., a favorite author). It is the perception of remaining time that matters (i.e., *future time perspective*; Carstensen, 2006); after imagining a medical advance that would add 20 years to their life expectancy, older adults' preferences look more like those of young adults (Fung, Carstensen, & Lutz, 1999). Most applications of SST to memory focus on emotion: older adults preferentially attend to and remember positive information (i.e., *positivity bias*) as part of their efforts to regulate emotion (Mather & Carstensen, 2005). The present work addresses the role that irrelevant positive information plays in older adults' truth judgments.

1.4 Current Studies

In eight experiments, this dissertation (a) identifies cues for truth and (b) characterizes their use across the lifespan. Older adults match or outperform young adults on measures of general knowledge. This begs the question - do older adults rely on their impressive knowledge bases, even when fluency leads to a different response? Replicating our previous work, repeating false claims (e.g., *The fastest land animal is the leopard*) misled young adults even when they "knew better" (e.g., that the fastest land animal is the cheetah, not the leopard). When claims contradicted older adults' stored knowledge, however, repetition did not influence their truth judgments (Experiments 1-2; Brashier, Umanath, Cabeza, & Marsh, 2017).

When falsehoods feel fluent, can we encourage young adults to "stick with what they know," as older adults do? We asked young adults to evaluate claims' truthfulness at exposure, thereby activating their knowledge. Initial truth ratings selectively benefited known items: Illusory truth was evident for unknown items (where there was no knowledge to activate at exposure), but markedly absent for known items. Critically evaluating information made young adults "look like" older adults (Experiments 3-5; Brashier, Drew, & Marsh, in preparation).

Finally, do we judge truth through "rose-tinted glasses," particularly in old age? Reliance on incidental affect may increase with age, given older adults' positivity bias in attention and memory. Young adults showed a negativity bias, where incidental anger or fear signaled that claims were false; positivity exerted no effect (Experiments 6-7). Strikingly, older adults evaluated truth more objectively, without being misled by irrelevant emotional information of any valence (Experiment 8; Brashier & Marsh, in preparation).

2. Older Adults Rely on Knowledge in the Face of Fluency[1]

For the unlearned, old age is winter; for the learned, it is the season of the harvest. – Hasidic proverb

In our youth-obsessed culture, we are surrounded by dubious claims that anti-aging products will "take years off our faces." Anti-wrinkle creams, for example, claim to harness the restorative power of "stem cell technology" with little scientific support and poor results (leading to successful class action law suits). Marketing campaigns such as these rely on repetition and the power of fluency – yet very few data speak to older adults' vulnerability to illusory truth. This oversight is surprising, since current models of the illusion emphasize a dynamic that shifts with age. According to Unkelbach and Stahl's (2009) multinomial model, people rely on fluency only if they fail to recollect whether or not a statement came from a credible source. Critically, the interplay between these two processes changes with age. Dual-process theories contrast how aging selectively impairs *recollection* (i.e., the ability to "relive" an event), while leaving familiarity (i.e., the feeling that an event occurred) intact (Light, 2012; Koehn & Yonelinas, 2014). As a result, repetition exerts "ironic effects" (Jacoby, 1999): Repetition increases recollection and reduces false memories in young adults, while it boosts

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familiarity and increases false memories in older adults (e.g., Benjamin, 2001; Budson, Daffner, Desikan, & Schacter, 2000; Light, Patterson, Chung, & Healy, 2004; McDermott & Chan, 2006; Skinner & Fernandes, 2009; Watson, McDermott, & Balota, 2004). A similar pattern unfolds when older adults evaluate truth. After a delay, young adults accurately assign more "false" ratings to trivia statements (e.g., *Corn chips contain twice as much fat as potato chips*) paired with a "false" label three times, compared to items presented once; by contrast, repeatedly presenting statements with a "false" label increases the likelihood that older adults misjudge them to be "true" later (Skurnik, Yoon, Park, & Schwarz, 2005). In daily life, though, incoming information rarely appears with an explicit "truth tag" and may lack an identifiable source altogether.

Without an explicit prompt to retrieve a source, fluency drives truth judgments, and age-related differences should disappear. Indeed, repeating trivia statements (e.g., *Austria and Switzerland are linked by the Brenner Pass*; Mutter, Lindsey, & Pliske, 1995) or false marketing claims (e.g., *British Airways has flown the greatest number of transcontinental passengers;* Law, Hawkins, & Craik, 1998) boosts truth ratings to a similar extent in young and older adults. These isolated studies merit replication, but more importantly, they ignore a third process involved in evaluating truth: retrieval of relevant knowledge. Counterintuitively, repeating contradictions of well-known facts (e.g., *A date is a dried plum*) makes young adults believe them, even when they "know better" (e.g., that drying plums produces prunes, not dates). Multinomial modeling confirmed that fluency can "trump" knowledge (Fazio et al., 2015).

This pattern may not extend to older adults, who match or even outperform young adults on measures of general knowledge (e.g., Arbuckle et al., 1994; Bahrick, 1984; Bowles & Poon, 1985; Burke & Peters, 1986; Cornelius & Caspi, 1987; Mitchell, 1989; Perlmutter, 1978; Staudinger, Cornelius, & Baltes, 1989). Do older adults rely on their impressive knowledge bases, even when fluency leads to a different response? Previous studies cannot address this question, given their ambiguous or fictitious materials (Law et al., 1998; Mutter et al., 1995; Skurnik et al., 2005). The simplest prediction is that, like young adults, repetition sways older adults' truth ratings regardless of their knowledge. Intriguingly, one experiment hints that instead, knowledge "protects" older adults. Parks and Toth (2006) indirectly examined the role of knowledge using brand names. They identified similar illusory truth effects in older and young adults for claims about unfamiliar brands (e.g., Raven's); interestingly, older adults exhibited a numerically smaller effect than young adults for claims about familiar brands (e.g., Chapstick). While suggestive, this pattern did not reach statistical significance, and the specific product claims were designed to be unknown even for well-known brands (e.g., *Chapstick contains seven percent wax*).

In two experiments, we specifically tested the independent contributions of fluency and knowledge to young and older adults' truth judgments. We measured whether participants held knowledge *directly* relevant to each claim, unlike Parks and Toth's (2006) brand manipulation. Participants rated their interest in claims, then judged the truth of these statements as well as new items. Finally, they completed a post-experimental knowledge check to establish which facts each participant had stored in memory. This design accommodates differences in the number of facts known by each age group, allowing us to focus instead on whether older adults draw on their knowledge more reliably than young adults do.

2.1 Experiments 1 and 2

These experiments share a design and very similar methods, so we report them together. They differ in the delay to final test (none in Experiment 1, 2 days in Experiment 2) and the strength of the fluency manipulation. Fluency effects emerge when something feels *relatively* easy to process compared to other items: They disappear when participants only rate repeated statements at test (Dechêne, Stahl, Hansen, & Wänke, 2009). To maximize the discrepancy between repeated and new items in Experiment 2, participants rated statements twice (rather than once) during the exposure phase. In addition, they rated a greater proportion of new statements during the truth phase. Both of these changes typically boost the size of the illusory truth effect (Dechêne et al., 2010), allowing a stronger test of our hypotheses in Experiment 2.

2.1.1 Method

2.1.1.1 Participants

Participants were tested individually or in small groups of up to three people. The Duke University Institutional Review Board approved all procedures. In Experiment 1, 40 Duke University undergraduates (24 female; 18 - 22 yrs) participated for course credit; forty-two students (32 female; 18 - 22 yrs) participated in Experiment 2. Forty-five community-dwelling older adults (26 female; 66 - 82 yrs) participated for monetary compensation in Experiment 1. Thirty-six older adults (20 female; 70 - 83 yrs) participated in Experiment 2. Two older and two young adults completed Experiment 2's online exposure phase but did not attend their in-lab sessions. We also excluded an older adult who reported misunderstanding the truth rating scale.

2.1.1.2 Design

Both experiments had a 2 (age: young, older) x 2 (repetition: repeated, new) x 2 (knowledge: known, unknown) mixed design. Repetition was manipulated within subjects, while knowledge varied within subjects.

2.1.1.3 Materials

We selected 176 facts from Tauber, Dunlosky, Rawson, Rhodes, and Sitzman's (2013) general knowledge norms that spanned a range of expected knowledge, then generated an additional 24 (Experiment 1) and 224 (Experiment 2) items of varying difficulty. The number of items differs across experiments, as Experiment 2 included more new items. We were most interested in how people evaluate false claims in their environment, so we converted facts (e.g., *The Theory of Relativity was proposed by Einstein*) into false statements by referring to plausible, but incorrect, alternatives (e.g., *The Theory of Relativity was proposed by Newton*). See Table 1 for sample statements. To prevent response bias, we included an equal number of true fillers. We divided the statements into two (Experiment 1) or four (Experiment 2) sets of 100 items. Half of each set appeared as falsehoods (i.e., critical items) and the other half appeared as truths (i.e., fillers) for all participants. One set repeated across exposure and truth rating phases, whereas the remaining one (Experiment 1) or three (Experiment 2) set(s) appeared for the first time during the truth rating phase. Repetition was counterbalanced across participants.

The final knowledge check consisted of multiple-choice questions about the falsehoods. The three answer options included the correct answer, the target misinformation presented earlier, and a *don't know* option. For example, the question *Who proposed the Theory of Relativity?* was accompanied by *Einstein*, *Newton*, and *don't know* answer choices. Since these items include both true (e.g., *Einstein*) and false (e.g., *Newton*) information, they do not encourage a response bias and no fillers were needed. For each participant, we categorized items as *known* or *unknown* based on knowledge check performance.

Table 1: Sample statements and multiple-choice questions.

	Statement	Knowledge Check
Likely Known	Deer meat is called veal.	What is the name for deer meat? (*venison*)
	The largest ocean on Earth is the Atlantic.	What is the largest ocean on Earth? (*Pacific*)
	The fastest land animal is the leopard.	What is the fastest land animal? (*cheetah*)
Likely Unknown	The capital of Chile is Lima.	What is the capital of Chile? (*Santiago*)
	The author of "Brothers Karamazov" is Tolstoy.	Who is the author of "Brothers Karamazov"? (*Dostoyevsky*)
	Billy the Kid's last name is Garrett.	What is Billy the Kid's last name? (*Bonney*)

2.1.1.4 Procedure

After giving informed consent, participants completed the first phase of the experiment, the *exposure phase*; in Experiment 2, this phase took place online.[2] Participants rated 100 statements for subjective interest, using a 6-point scale from 1

[2] We cannot rule out the possibility that participants looked up answers during the online exposure phase (Experiment 2), but reaction time data suggest that this took place infrequently, if at all. Very few (<1%) interest ratings took longer than 60s.

(*very interesting*) to 6 (*very uninteresting*). They completed this task once (Experiment 1) or twice (Experiment 2). The experimenter informed participants that some statements were true and others false.[3]

Either immediately after exposure (Experiment 1) or 1-3 days later (Experiment 2), participants completed the second part of the experiment, the *truth rating phase*, in the lab. In addition to the warning that they would encounter true and false statements, the experimenter told participants that some statements appeared earlier in the experiment, while others were new. Participants rated 200 (Experiment 1) or 400 (Experiment 2) statements for truthfulness, using a scale from 1 (*definitely false*) to 6 (*definitely true*).

Following the truth rating phase, participants completed the final *knowledge check*. Participants answered 100 (Experiment 1) or 200 (Experiment 2) multiple-choice questions with three response options: the correct answer, the alternative embedded in the falsehood seen earlier, and *don't know*. The experimenter asked participants to indicate *don't know* instead of guessing any answers. We classified each statement as *known* or *unknown* on the basis of whether a given participant could answer the corresponding question correctly later. That is, a "known falsehood" refers to a knowledge check question that a participant answered correctly and saw in a false

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[3] Preliminary data suggest that this simple warning reduces the size of the illusory truth effect (Jalbert, Newman, & Schwarz, 2018).

framing during the earlier exposure and truth rating phases. Participants did not receive explicit labels or any other indications that specific statements were true or false.

2.1.2 Results

The alpha level for all statistical tests was set at .05. As discussed above, analyses focused on responses to falsehoods (i.e., critical items). Planned comparisons tested whether illusory truth varied with knowledge, within each age group.

2.1.2.1 Knowledge Check

We first assessed knowledge check performance to ensure that our materials spanned a range of difficulty. Young adults answered many of the knowledge check questions correctly (known items; Experiment 1: 40%; Experiment 2: 37%). They responded to some of the questions with falsifications (Experiment 1: 22%; Experiment 2: 8%), but more frequently responded *don't know* (Experiment 1: 38%; Experiment 2: 55%). We collapsed across incorrect and *don't know* responses (unknown items; Experiment 1: 60%; Experiment 2: 63%). Unsurprisingly, older adults outperformed young adults on the knowledge check: They answered more questions correctly (Experiment 1: 63%; Experiment 2: 52%) and responded with falsifications (Experiment 1: 15%; Experiment 2: 7%) and *don't know* (Experiment 1: 21%; Experiment 2: 41%) less often. Again, we collapsed across incorrect and *don't know* responses (unknown items; Experiment 1: 37%; Experiment 2: 48%). The high *don't know* rate for both groups indicates that correct answers corresponded to actual knowledge, rather than guesses.

Note that the knowledge check likely underestimates people's knowledge, since viewing the false version of a statement may bias people to choose the wrong answer later (Bottoms, Eslick, & Marsh, 2010; Kamas, Reder, & Ayers, 1996).

2.1.2.2 Truth Ratings

We conducted a 2 (age: young, older) x 2 (knowledge: known, unknown) x 2 (repetition: repeated, new) mixed ANOVA on participants' truth ratings for falsehoods. The number of known and unknown items varied for each participant, depending on his or her knowledge check performance (Experiment 1: minimum trials per cell = 6, *M* trials per cell = 25; Experiment 2: minimum trials per cell = 8; *M* trials per cell = 50). To preview, both experiments yielded the same pattern: Young adults exhibited illusory truth, regardless of their stored knowledge, whereas knowledge protected older adults. The relevant data appear in Figure 1.

Replicating the standard illusory truth effect, repeated falsehoods (Experiment 1: $M = 3.55$; Experiment 2: $M = 3.35$) received higher truth ratings than new falsehoods (Experiment 1: $M = 3.33$; Experiment 2: $M = 3.09$) [Experiment 1: $F(1, 83) = 22.39$, $p < .001$, $\eta_p^2 = .21$; Experiment 2 $F(1, 76) = 34.21$, $p < .001$, $\eta_p^2 = .31$]. As expected, known falsehoods (Experiment 1: $M = 2.93$; Experiment 2: 2.58) received lower (i.e., more accurate) truth ratings than unknown ones (Experiment 1: $M = 3.95$; Experiment 2: $M = 3.87$) [Experiment 1: $F(1, 83) = 331.90$, $p < .001$, $\eta_p^2 = .80$; Experiment 2: $F(1, 76) = 486.67$, $p < .001$, $\eta_p^2 = .87$].

Overall, older adults (Experiment 1: $M = 3.26$; Experiment 2: $M = 2.96$) used the truth rating scale more cautiously than young adults (Experiment 1: $M = 3.62$; Experiment 2: $M = 3.48$) [Experiment 1: $F(1, 83) = 10.32$, $p = .002$, $\eta_p^2 = .11$; Experiment 2: $F(1, 76) = 25.15$, $p < .001$, $\eta_p^2 = .25$]; they (Experiment 1: known $M = 2.67$, unknown $M = 3.84$; Experiment 2: known $M = 2.21$, unknown $M = 3.71$) also applied their knowledge more consistently than young adults (Experiment 1: known $M = 3.19$, unknown $M = 4.06$; Experiment 2: known $M = 2.94$, unknown $M = 4.02$) [Experiment 1: $F(1, 83) = 7.18$, $p = .009$, $\eta_p^2 = .08$; Experiment 2: $F(1, 76) = 13.36$, $p < .001$, $\eta_p^2 = .15$] did. Since illusory truth is a *relative* effect defined by the difference between ratings of repeated and new items, our design accommodates any baseline differences in young and older adults' approaches to the task.

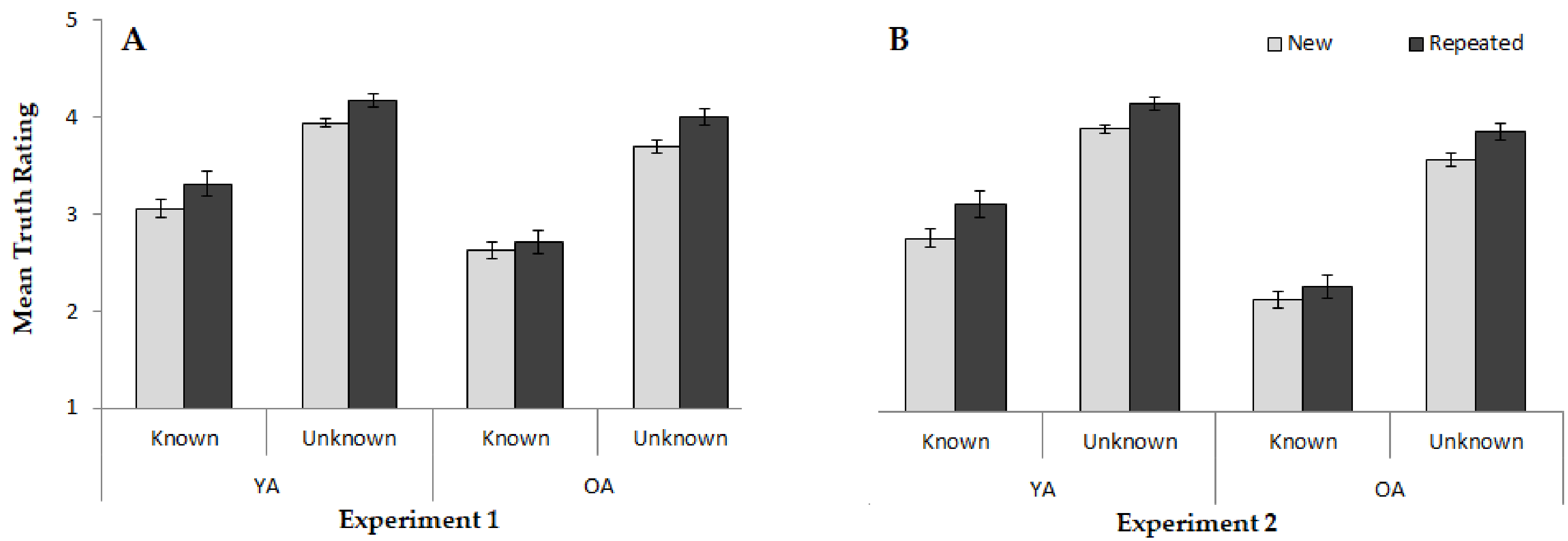

Figure 1: Mean truth ratings for falsehoods as a function of age, knowledge, and repetition in Experiments 1 (A) and 2 (B). Error bars reflect standard error of the mean. YA = young adults; OA = older adults.

The three-way interaction among age, knowledge, and repetition was significant in Experiment 2, $F(1, 76) = 4.03$, $p = .048$, $\eta_p^2 = .05$, and not in Experiment 1, $F(1, 83) = 2.08$, $p = .153$, , $\eta_p^2 = .02$, though the pattern of means was the same. Older adults exhibited illusory truth for unknown [Experiment 1: repeated $M = 4.00$; new $M = 3.69$, $t(44) = 3.89$, $p < .001$; Experiment 2: repeated $M = 3.85$; new $M = 3.57$, $t(35) = 4.76$, $p < .001$] but not known [Experiment 1: repeated $M = 2.72$; new $M = 2.62$, $t(44) = 1.31$, $p = .197$; Experiment 2: repeated $M = 2.28$; new $M = 2.14$, $t(35) = 1.75$, $p = .09$] falsehoods. Conversely, young adults demonstrated illusory truth for both known [Experiment 1: repeated $M = 3.31$; new $M = 3.06$, $t(39) = 2.00$, $p = .052$; Experiment 2: repeated $M = 3.12$; new $M = 2.77$, $t(41) = 3.60$, $p = .001$] and unknown falsehoods [Experiment 1: repeated $M = 4.17$; new $M = 3.94$, $t(39) = 3.42$, $p = .001$; Experiment 2: repeated $M = 4.15$; new $M = 3.89$, $t(41) = 5.06$, $p < .001$].

We cannot address whether initial interest influenced illusory truth, as participants did not rate their interest in new items (which, by definition, did not appear at exposure). For completeness, we note that an illusory truth effect emerged for true fillers: Repeated truths (Experiment 1: $M = 4.74$; Experiment 2: $M = 4.63$) received higher truth ratings than new ones (Experiment 1: $M = 4.60$; Experiment 2: $M = 4.45$) [Experiment 1: $t(84) = 4.88$, $p < .001$; Experiment 2: $t(77) = 5.84$, $p < .001$].

2.2 Discussion

The present research investigated older adults' vulnerability to fluency when evaluating claims that contradicted their stored knowledge. Young and older adults responded similarly when fluency provided the only cue for truth; when neither recollection nor knowledge retrieval could play a significant role (i.e., for unknown items), both age groups exhibited a robust illusory truth effect. These data complement the findings that repetition increases liking (Halpern & O'Connor, 2000; Wiggs, 1993) and truth judgments (Law et al., 1998, Mutter et al., 1995), regardless of age.

Most interestingly, we identified a protective effect of knowledge among older, but not young, adults. Repetition misled young adults even when they held relevant knowledge about a claim, replicating Fazio and colleagues' (2015) finding that young adults sometimes neglect their knowledge when they can use fluency instead. When claims contradicted older adults' stored knowledge, however, repetition exerted little to no influence on their truth ratings. In other words, the literature's assumption that statements must be "ambiguous" for illusory truth to occur (Dechêne et al., 2010) applies selectively to older adults, a group ironically assumed to be more vulnerable to fluency. Typically, older adults exhibit more automatic, or "habitual," responses than young adults due to a breakdown of controlled processes (i.e., recollection; Hay & Jacoby, 1996; Hay & Jacoby, 1999; Jacoby & Rhodes, 2006). In an inversion of this pattern, older adults engaged in controlled processes (i.e., knowledge retrieval) more consistently than did young adults. This finding is robust, as we replicated it with binary (i.e., *true* or *false*) truth ratings in a smaller experiment (n = 21), where older adults exhibited illusory truth for unknown (repeated *M* = 0.60; new *M* = 0.48), but not known (repeated *M* = 0.30; new *M* = 0.26), statements, $F(1, 20) = 6.86$, $p = .016$, $\eta_p^2 = .26$.

Critically, older adults' performance cannot be attributed to the fact that they simply know more than young adults. Rather than relying on norms, we defined items as known or unknown on the basis of each individual's knowledge check performance. Thus, our conditional analyses controlled for the quantity of knowledge held by each age group. Instead, our results may reflect the structure of older adults' knowledge: Much like experts (Chi, Feltovich, & Glaser, 1981; Medin, Lynch, Coley, & Atran, 1997), older adults likely hold knowledge that has been frequently rehearsed and is highly organized. These qualities reduce the effort associated with retrieving and applying relevant facts, which may explain the discrepancy between our findings and older adults' documented "reluctance" to retrieve recent events (i.e., episodic retrieval; Touron, 2015). Alternatively, older adults' resilience may reflect a strategic bias to rely on knowledge (see Umanath & Marsh, 2014, for a review).

Indeed, episodic memory deficits can encourage the use of knowledge as a compensatory technique (Bayen, Nakamura, Dupuis, & Yang, 2000; Spaniol & Bayen, 2002). Knowledge about music (Arbuckle, Vanderleck, Harsany, & Lapidus, 1990), occupations (e.g., banking, medicine; Besken & Gülgöz, 2009), and grocery shopping (Castel, 2005) boosts older adults' recall performance and can even eliminate age-related differences completely. Knowledge clearly plays a role in offsetting deficits in recollection, but our data address the other half of the dual-process framework: using knowledge to combat fluency. The present findings complement and extend, rather than contradict, dual-process theories of aging. Considering a third factor, retrieval of relevant knowledge, helps to explain older adults' schematic memory errors; "ironic" effects of repetition probably reflect both fluency and the use of knowledge to "fill in the gaps" (e.g., Henkel, 2013; McDermott & Chan, 2006; Skinner & Fernandes, 2009).

Of course, relying on knowledge is not usually the fastest strategy. Inferring truth from fluency typically leads to the correct judgment in less time than a more effortful strategy (Unkelbach, 2007). Older adults probably search memory for relevant knowledge in situations where the automatic, fluent response is the correct one. Despite the time and effort involved, we expect that older adults' bias to use their knowledge improves the quality of their everyday judgments. For one, it challenges the widespread assumption that older adults are vulnerable consumers. The National Council on Aging, for example, warns that financial scams directed at older adults constitute the "crime of the 21st century." Similarly, the National Institute on Aging cautions that cosmetic and health products touting "anti-aging" benefits mislead a vulnerable population. These concerns are not borne out by survey data: Fraud victimization actually occurs less frequently in older than in young consumers (Ross, Grossman, & Schryer, 2014). The present data suggest that repeating false claims about an unknown product misleads young and older consumers to a similar extent. Encouragingly, repeating false claims about a well-known product category probably would not sway older adults' judgments. Older adults' accumulated knowledge and their tendency to rely on it can provide powerful protection against misinformation and scams.

3. Evaluating Truth Prompts Young Adults to Use Knowledge[1]

The truth isn't always beauty, but the hunger for it is. – Nadine Gordimer

In 2013, CNN and a former CIA analyst mistakenly named the Czech Republic, rather than Chechnya (a Russian province), as the birthplace of the Boston Marathon bombers. Despite the fact that viewers likely heard the correct referent (Chechnya) in other media coverage, they failed to notice the error. A frenzy ensued on social media, culminating in the Czech ambassador's public plea for Americans to stop wrongfully blaming his country. Disturbingly, we often nod along when incoming information contradicts our knowledge. People willingly answer questions containing false premises (e.g., *How many animals of each kind did Moses take on the ark?*; the *Moses illusion*; Erickson & Mattson, 1981), generate solutions to impossible problems (e.g., where to bury survivors of a plane crash; Barton & Sanford, 1993), and overlook inaccuracies embedded in stories (e.g., a reference to St. Petersburg as Russia's capital; Marsh & Fazio, 2006). These slips occur even though people know the story of Noah's ark, the definition of "survivor," and the capital of Russia.

Fluency further impairs our ability to catch contradictions. People notice fewer errors when questions like *How many animals of each kind did Moses take on the ark?* appear

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[1] Adapted from Brashier, N. M., Drew E. E., & Marsh, E. J. (in preparation). Sticking to what you know: Evaluating truth prompts later reliance on knowledge.

in easy-to-read fonts (Song & Schwarz, 2008). Even when people are explicitly asked whether or not information is true, fluency can "trump" knowledge. Repeating claims like *The Theory of Relativity was proposed by Newton* makes them seem truer, even though people know that these ideas belong to Einstein, not Newton (Brashier et al., 2017; Fazio et al., 2015).

Knowledge is not always protective, perhaps because people do not always strive for accuracy. We avoid information that is free and useful (Golman, Hagmann, & Loewenstein, 2017); prefer to remain ignorant of future events (Gigerenzer & Garcia-Retamero, 2017); share information we know to be false (Pennycook et al., in preparation, Pew Research Center, 2016); and "tune" messages to our audience (DePaulo & Coleman, 1986; Pasupathi, Stallworth, & Murdoch, 1998) and conversational goal. For example, stories told to entertain differ from those told to inform, with consequences for how the original events are remembered later (Dudukovic, Marsh, & Tversky, 2004). By extension, people likely judge incoming information without an explicit focus on accuracy, leaving them vulnerable to repetition.

Crucially, older adults retrieve their knowledge even when falsehoods are fluent. Unlike young adults, repeating *The fastest land animal is the leopard* does not sway them (Brashier et al., 2017). Given the strong appeal of a fluency heuristic, can we encourage young adults to "stick with what they know," as older adults do? This is no small task, as people only require a "partial match" between the contents of a statement and what is stored in memory (see Reder & Kusbit, 1991). Telling people to consider their knowledge (Rapp, 2008), re-reading (Jacovina, Hinze, & Rapp, 2014), and drawing attention to errors (e.g., displaying in red font, Eslick, Fazio, & Marsh, 2011) prove ineffectual. These approaches do not force people to retrieve specific facts – you can reject *A dried plum is a date* without thinking of the correct answer (i.e., *prune*, recalling to reject). Instead, we investigated whether judging truth at exposure explicitly encourages a focus on accuracy and retrieval of relevant knowledge. Previous studies asked for initial truth ratings (e.g., Arkes et al., 1989; Bacon, 1979; Boehm, 1994), but used ambiguous materials (i.e., there was no knowledge to activate) and do not speak to this question.

In three experiments, we tested a promising strategy: asking young adults to evaluate well-known claims' truthfulness at exposure, thereby activating their knowledge. Participants assigned interest or truth ratings to statements, then judged the truth of these statements and new items. Knowledge was defined by Tauber and colleagues' (2013) norms (Experiments 3 and 4), as well as individuals' performance on a post-experimental knowledge check (Experiment 5).

3.1 Experiment 3

3.1.1 Method

3.1.1.1 Participants

One hundred and four workers (52 female; *M* age = 36.82 years) on Amazon Mechanical Turk (MTurk) participated for compensation. We also excluded one participant who reported looking up answers to the trivia items.

3.1.1.2 Design

This experiment had a 2 (initial rating: interest, truth) x 2 (repetition: repeated, new) mixed design. Initial rating type was manipulated between subjects, while repetition was manipulated within subjects.

3.1.1.3 Materials

We selected 60 facts from Tauber and colleagues' (2013) general knowledge norms that were likely to be known (on average, answered correctly by 60% of norming participants), then generated an additional 60 items of similar difficulty. As in Experiments 1-2, we converted facts (e.g., *The inability to sleep is insomnia*) into false statements by referring to plausible, but incorrect, alternatives (e.g., *The inability to sleep is apnea*). Again, we included an equal number of true fillers. We divided the statements into four sets of 30 items. Two sets appeared as falsehoods (i.e., critical items) and the other two appeared as truths (i.e., fillers) for all participants. One set of falsehoods repeated across exposure and truth rating phases, whereas the other appeared for the first time during the truth rating phase. Repetition was counterbalanced across participants for falsehoods.

3.1.1.4 Procedure

After giving informed consent, participants completed the first phase of the experiment, the *exposure phase*. Depending on condition, participants rated 60 statements for either interest, on a scale from 1 (*very uninteresting*) to 6 (*very interesting*), or truthfulness, using a scale from 1 (*definitely false*) to 6 (*definitely true*). They received a warning that some statements were true and others false.

Immediately after exposure, participants completed the second part of the experiment, the *truth rating phase*. In addition to the warning that they would encounter true and false statements, participants read that some statements appeared earlier in the experiment, while others were new. They also received instructions not to worry about matching their previous ratings. Participants rated 120 statements for truthfulness, using a scale from 1 (*definitely false*) to 6 (*definitely true*).

3.1.2 Results

The alpha level for all statistical tests was set at .05. As discussed above, analyses focused on responses to falsehoods (i.e., critical items). Planned comparisons tested whether illusory truth varied with initial rating type.

We conducted a 2 (initial rating: interest, truth) x 2 (repetition: repeated, new) mixed ANOVA on participants' truth ratings for falsehoods. The relevant data appear in Figure 2. Main effects of initial rating ($F < 1$) and repetition, $F(1, 101) = 1.61$, $p = .207$, were not significant. Critically, we found an interaction between initial rating and repetition, $F(1, 101) = 5.70$, $p = .019$, $\eta_p^2 = .05$. For participants in the standard condition (initial interest ratings), repeated falsehoods ($M = 2.85$) received higher final truth ratings than new ones ($M = 2.69$), $t(51) = 2.40$, $p = .020$. For participants who critically evaluated claims (initial truth ratings), however, repeated ($M = 2.69$) and new ($M = 2.74$) falsehoods received similar final ratings, $t(50) = 0.87$, $p = .390$.

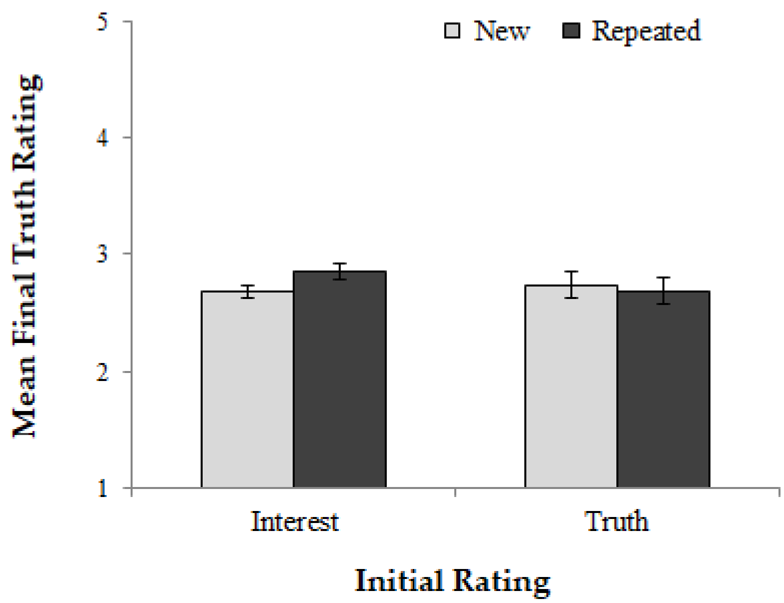

Figure 2: Mean truth ratings for falsehoods as a function of initial rating type and repetition in Experiment 3. Error bars reflect standard error of the mean.

3.1.3 Discussion

As expected, after initial interest ratings, participants neglected their knowledge when they could draw inferences based on fluency. Critically evaluating claims (i.e., initial truth ratings) wiped out the illusion, perhaps by activating knowledge. However, initial truth ratings might affect performance in several ways (e.g., increasing exposure time, encouraging a skeptical approach). Indeed, participants rated truth (*M* = 5517.18 ms) more slowly than they rated interest (*M* = 4179.77 ms) at exposure. To rule out these possibilities, Experiment 4 includes items that span a range of difficulty. If initial truth ratings activate knowledge, they should reduce illusory truth for known, but not unknown, claims. Despite instructions not to think back to the initial phase, participants may also have anchored final truth ratings around initial ones (e.g., "I said 'probably true' before, so I will stick with my answer"). To discourage anchoring, Experiment 4 used a binary (rather than continuous) scale for final judgments.

3.2 Experiment 4

3.2.1 Method

3.2.1.1 Participants

Ninety-nine Duke University undergraduates (66 female; M age = 21.44 years) participated for monetary compensation.

3.2.1.2 Design

This experiment had a 2 (initial rating: interest, truth) x 2 (repetition: repeated, new) x 2 (estimated knowledge: known, unknown) mixed design. Initial rating type was manipulated between subjects, while repetition and knowledge were manipulated within subjects.

3.2.1.3 Materials

We selected 104 facts from Tauber and colleagues' (2013) general knowledge norms that spanned a range of expected knowledge, then generated an additional 96 items of varying difficulty. Again, we converted facts into false statements by referring to plausible, but incorrect, alternatives. See Table 1 for sample statements. To prevent response bias, we included an equal number of true fillers. We divided the statements into four sets of 50 items. Two sets appeared as falsehoods (i.e., critical items) and the other two appeared as truths (i.e., fillers) for all participants. One set of falsehoods repeated across exposure and truth rating phases, whereas the other appeared for the first time during the truth rating phase. Repetition was counterbalanced across participants for falsehoods.

3.2.1.4 Procedure

The procedure was identical to that of Experiment 3, with the exceptions that (a) participants judged more claims during the exposure (100 statements) and truth rating (200 statements) phases and (b) they provided binary (*true*, *false*) final truth ratings.

3.2.2 Results

Unlike Experiment 3, we performed analyses on the proportion of statements rated "true." Planned comparisons tested whether illusory truth varied with initial rating type.

We conducted a 2 (initial rating: interest, truth) x 2 (estimated knowledge: known, unknown) x 2 (repetition: repeated, new) mixed ANOVA on participants' truth ratings for falsehoods. The relevant data appear in Figure 3. Replicating the standard illusory truth effect, repeated falsehoods ($M = 0.56$) received higher truth ratings than new falsehoods ($M = 0.49$), $F(1, 97) = 30.57$, $p < .001$, $\eta_p^2 = .24$. Unsurprisingly, known falsehoods ($M = 0.48$) received lower (i.e., more accurate) truth ratings than unknown ones ($M = 0.57$), $F(1, 97) = 25.59$, $p < .001$, $\eta_p^2 = .21$.

Overall, participants in the initial truth condition ($M = 0.50$) used the final truth rating scale more cautiously than those in the initial interest condition ($M = 0.48$), $F(1, 97) = 4.02$, $p = .048$, $\eta_p^2 = .04$. Since illusory truth is a *relative* effect defined by the difference between ratings of repeated and new items, our design accommodates any baseline differences in the two groups' approaches to the task.

The three-way interaction among initial rating, knowledge, and repetition was not significant, $F(1, 97) = 2.29$, $p = .133$. However, the pattern of means suggested that initial truth ratings selectively benefited judgments of known items. Participants in the standard condition (initial interest ratings) demonstrated illusory truth for both unknown (repeated $M = 0.67$; new $M = 0.55$, $t(48) = 5.28$, $p < .001$) and known (repeated $M = 0.56$; new $M = 0.46$, $t(48) = 5.04$, $p < .001$) falsehoods. Participants who critically evaluated claims (initial truth ratings) exhibited illusory truth for unknown (repeated M

= 0.56; new M = 0.51, $t(49) = 2.61$, $p = .012$) but not known (repeated M = 0.43; new M = 0.46, $t(49) = 1.41$, $p = .165$) falsehoods.

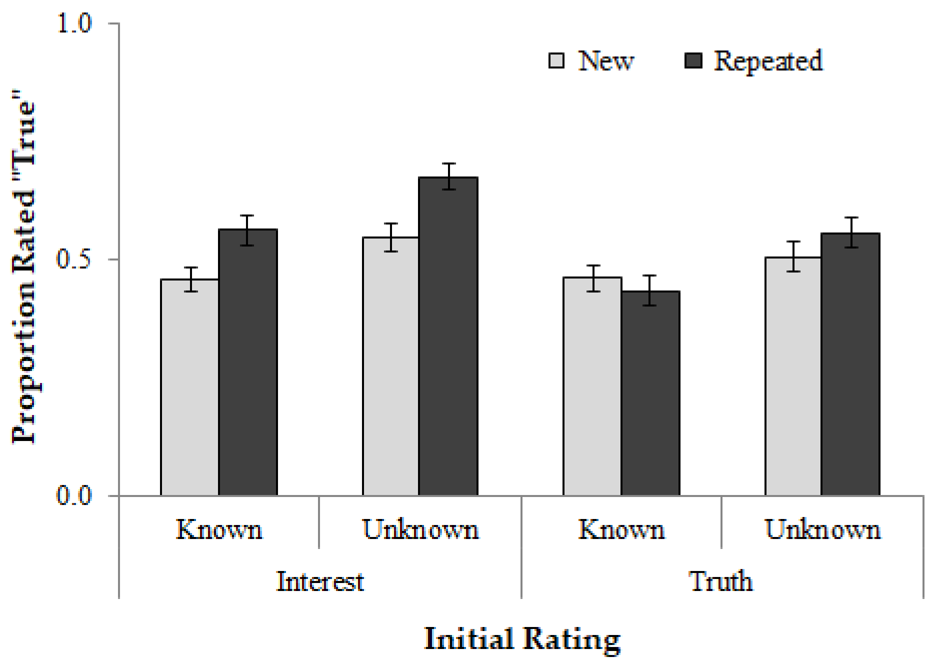

Figure 3: Proportion of falsehoods rated "true" as a function of initial rating type, norm-based estimates of knowledge, and repetition in Experiment 4. Error bars reflect standard error of the mean.

3.2.3 Discussion

Again, participants who completed a standard exposure task (i.e., initial interest ratings) exhibited illusory truth, regardless of their knowledge. Initial truth ratings selectively benefited known items: Illusory truth was evident for unknown items (where there was no knowledge to activate at exposure), complementing the finding that "deep" processing does not reverse, and can even enhance, illusory truth (Unkelbach &

Rom, 2017). The illusion was markedly absent for known items. Rather than simply increasing exposure time or engendering skepticism, critically evaluating information appears to activate knowledge stored in memory. The three-way interaction did not reach statistical significance, perhaps because we estimated knowledge using norms. Experiment 5 measured which facts each participant had stored in memory, allowing a stronger test of our hypotheses.

3.3 Experiment 5

3.3.1 Method

3.3.1.1 Participants

Sixty-eight Duke University undergraduates (35 female; *M* age = 19.31 years) participated for course credit.

3.3.1.2 Design

This experiment had the same design as Experiment 4, except that knowledge varied within subjects.

3.3.1.3 Materials

We used the same statements as in Experiment 4. The final knowledge check consisted of multiple-choice questions about the falsehoods. The three answer options included the correct answer, the target misinformation presented earlier, and a *don't know* option. For example, the question *What is the name for the inability to sleep?* was accompanied by *insomnia*, *apnea*, and *don't know* answer choices. See Table 1 for sample questions. Since these items include both true (e.g., *insomnia*) and false (e.g., *apnea*) information, they do not encourage a response bias and no fillers were needed. For each participant, we categorized items as *known* or *unknown* based on knowledge check performance.

3.3.1.4 Procedure

The procedure was identical to that of Experiment 4, with the exceptions that (a) participants assigned continuous truth ratings using a 6-point scale (as in Experiment 3) and (b) they completed a knowledge check. The final *knowledge check* included 100 multiple-choice questions with three response options: the correct answer, the alternative embedded in the falsehood seen earlier, and *don't know*. The experimenter asked participants to indicate *don't know* instead of guessing any answers. We classified each statement as *known* or *unknown* on the basis of whether a given participant could answer the corresponding question correctly later. That is, a "known falsehood" refers to a knowledge check question that a participant answered correctly and saw in a false framing during the earlier exposure and truth rating phases. Participants did not receive explicit labels or any other indications that specific statements were true or false.

3.3.2 Results

Again, analyses focused on responses to falsehoods (i.e., critical items). Planned comparisons tested whether illusory truth varied with initial rating type.

3.3.2.1 Knowledge Check

We first assessed knowledge check performance to ensure that our materials spanned a range of difficulty. Overall, participants answered 44% of the knowledge check questions correctly (known items). They responded to 8% of the questions with falsifications, and to another 48% with *don't know*. Collapsing across these response types, 56% of the items were unknown. The high *don't know* rate indicates that correct answers corresponded to actual knowledge, rather than guesses. Again, the knowledge check likely underestimates people's knowledge, since viewing the false version of a statement may bias people to choose the wrong answer later (Bottoms et al., 2010; Kamas et al., 1996).

3.3.2.2 Truth Ratings

We conducted a 2 (initial rating: interest, truth) x 2 (demonstrated knowledge: known, unknown) x 2 (repetition: repeated, new) mixed ANOVA on participants' truth ratings for falsehoods. The number of known and unknown items varied for each participant, depending upon on his or her knowledge check performance. Every participant's data included a minimum of 11 trials per cell, and the average trial count per cell was 25. The relevant data appear in Figure 4.

Again, repeated falsehoods (M = 3.34) received higher truth ratings than new falsehoods (M = 3.23), $F(1, 66) = 5.42$, $p = .023$, $\eta_p^2 = .08$. As expected, known falsehoods (M = 2.59) received lower (i.e., more accurate) truth ratings than unknown ones (M =

3.97), $F(1, 66) = 352.81$, $p < .001$, $\eta_p^2 = .84$. Overall, participants in the initial truth condition ($M = 3.16$) used the final truth rating scale more cautiously than those in the initial interest condition ($M = 3.40$), $F(1, 66) = 6.24$, $p = .015$, $\eta_p^2 = .09$; they (known M = 2.38, unknown $M = 3.94$) also applied their knowledge more consistently than those in the standard condition (known $M = 2.80$, unknown $M = 4.00$) did, $F(1, 66) = 6.10$, $p = .016$, $\eta_p^2 = .09$. Again, our design accommodates any baseline differences in the two groups' approaches to the task.

The three-way interaction among initial rating, knowledge, and repetition was significant, $F(1, 66) = 8.13$, $p = .006$, $\eta_p^2 = .11$. Participants in the standard condition (initial interest ratings) demonstrated illusory truth for both unknown (repeated M = 4.07; new $M = 3.93$, $t(34) = 2.23$, $p = .033$) and known (repeated $M = 2.95$; new $M = 2.66$, $t(34) = 2.54$, $p = .016$) falsehoods. Participants who critically evaluated claims (initial truth ratings) exhibited illusory truth for unknown (repeated $M = 4.02$; new $M = 3.87$, $t(32) = 2.82$, $p = .008$) but not known (repeated $M = 2.32$; new $M = 2.44$, $t(32) = 1.20$, p = .238) falsehoods.

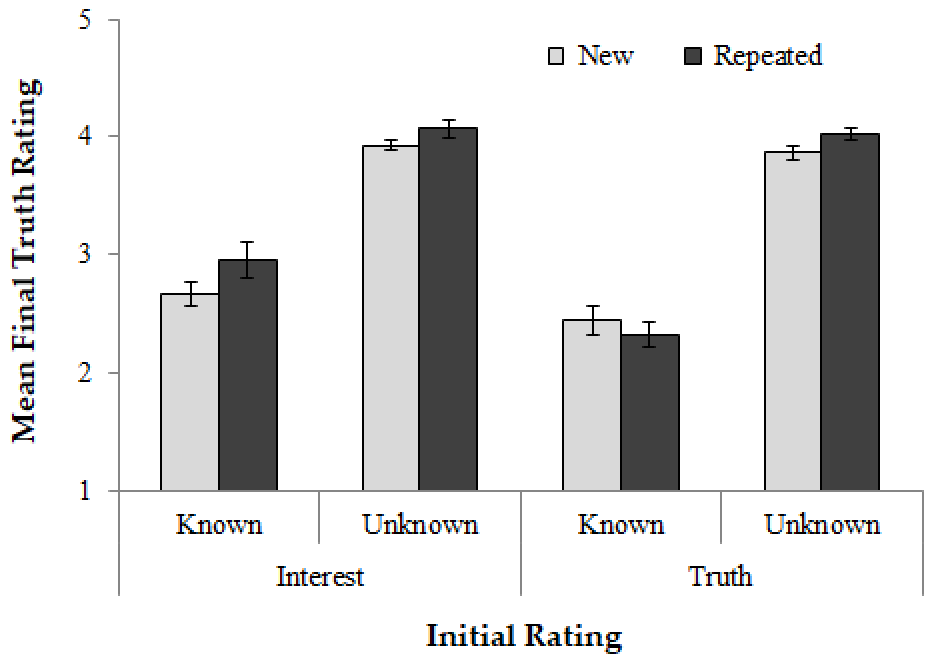

Figure 4: Mean truth ratings for falsehoods as a function of initial rating type, knowledge, and repetition in Experiment 5. Error bars reflect standard error of the mean.

3.4 Discussion

The present research prompted young adults to consider their knowledge, even when falsehoods were fluent. Initial truth ratings completely eliminated illusory truth when people held relevant knowledge; if anything, known falsehoods received nominally *lower* truth ratings with repetition. These findings are impressive, given that illusory truth stubbornly emerges even after long delays (Brown & Nix, 1996), warnings (Nadarevic & Aßfalg, 2016), and explicit indications that sources are unreliable (Henkel & Mattson, 2011).

Interestingly, people spontaneously "suspend" other dominant heuristics in favor of relevant knowledge. When deciding which of two cities (e.g., *Modena*, *Milan*) is larger, people overwhelmingly choose the recognized alternative (e.g., *Milan*; see Pachur, Todd, Gigerenzer, Schooler, & Goldstein, 2011, for a review). Half of participants indicate that recognized cities are larger on *every single trial* – even when unrecognized cities boast significant industries, airports, and major national soccer teams (reliable indicators of city size; Pachur, Bröder & Marewski, 2008). Much like fluency, reliance on a *recognition heuristic* exploits a "by product" of cognition, predicts real-world outcomes (e.g., winners of elections; Marewski, Gaissmaier, Schooler, Goldstein, & Gigerenzer, 2010), and has clear neural correlates (in anterior frontomedian cortex, precuneus, and retrosplenial cortex; Volz et al., 2006). Though recognition usually dominates inferences about quantity, knowledge can supersede it. Oppenheimer (2003) asked Bay Area residents to indicate which were larger: small, nearby cities (e.g., *Milpitas*) or fictional cities (e.g., *Rio Del Sol*). Instead of inferring that recognized cities were larger, participants drew upon their knowledge (i.e., that the well-known cities were small) and chose the fictional cities. While older adults naturally "suspend" the fluency heuristic in favor of knowledge, young adults must be encouraged to do so. Interestingly, experts may lie somewhere in the middle – history graduate students pass over errors in their domain of expertise (e.g., answer questions like *In what US state were the forty-niners searching for oil?*), albeit less often than novices do (Cantor & Marsh, 2016).

“Fake news” headlines, propaganda, and misleading advertisements tend to be repeated, suggesting the importance of an evaluative strategy that “activates” knowledge. Such an approach takes advantage of information already stored in memory, generalizes across domains (e.g., advertisements, politicians’ speeches), feels less invasive than censoring or manipulating content (see public outcry to Kramer, Guillory, & Hancock, 2014), and is easily implemented; a simple Chrome extension could insert an *is this true?* icon next to headlines that appear in our newsfeeds and Google search results. Notably, it is neither feasible nor efficient to carefully evaluate the truthfulness of every single claim in our environment. Searching memory requires time and effort, whereas fluent judgments are fast, easy, and (in most cases) accurate (Unkelbach, 2007). Carefully judging truth should be reserved for high-stakes judgments (e.g., about large purchases or voting behavior) in domains where people have background knowledge. This approach will be most helpful when false claims tend to closely resemble the truth (see Hinze, Slaten, Horton, Jenkins, & Rapp, 2014; van Oostendorp, H., & de Mul, S., 1990) – repeating implausible claims (e.g., *The earth is a perfect square*; Pennycook et al., in preparation) does not make people believe them.

4. Neither Young nor Older Adults Conflate Positivity with Truth[1]

I don't believe in aging. I believe in forever altering one's aspect to the sun. Hence my optimism. – Virginia Woolf

I'd like to buy the world a Coke. In 1971, Coca Cola released an iconic advertisement in which throngs of young people sang together on the cliffs of Dover. In response, the company received over 100,000 letters of praise and requests for the sheet music. *Joy marketing* is still in full effect today (e.g., McDonald's *I'm lovin it* campaign), capitalizing on people's tendency to consider affect as a source of information, even when it is unrelated to the judgment at hand. We ask ourselves *How do I feel about this?* and then attribute our feelings to the target (Schwarz, 2012). In one prominent example, positivity implies familiarity, and vice versa. Positive faces feel more familiar than neutral ones (Garcia-Marques, Mackie, Claypool, & Garcia-Marques, 2004), and familiar faces appear happier than new ones (Carr, Brady & Winkielman, 2017). Easy processing "feels good," according to both self-reports (Monahan et al., 2000) and facial myography (i.e., activity over the zygomaticus "smiling" muscle, Carr et al., 2016; Winkielman & Cacioppo, 2001). Happy, but not sad, people endorse attitudes based on easy-to-retrieve (i.e., fluent) arguments (Ruder & Bless, 2003). Compared to a neutral mood, happiness encourages people to falsely recognize words (i.e., call them "old," Claypool, Hall,

[1] Adapted from Brashier, N. M. & Marsh, E. J. (in preparation). Positivity does not cue truth.

Mackie, & Garcia-Marques, 2008). Given this "warm glow" of familiarity, it is unsurprising that negative mood wipes out illusory truth (Koch & Forgas, 2012) and helps people detect deception (Forgas & East, 2008).

Does fluency provide any unique information, or is it simply redundant with affect? Unkelbach and colleagues (2011) found similar illusory truth effects for claims with positive (*The divorce rate in Grenada is lower than in the rest of Spain*) and negative (*The divorce rate in Grenada is higher than in the rest of Spain*) framings. Moreover, multinomial modeling suggests that people guess "true" more often when statistical statements have a *negative*, rather than positive, framing (Hilbig, 2012). Thus, fluency appears to convey metacognitive information above and beyond positivity. While framing impacts mood, it is not the strongest manipulation of affect (i.e., "good feelings" elicited by positive framings only averaged 65.58 out of 100 on a visual analogue scale; Unkelbach et al., 2011). In addition, elicited feelings came directly from the information that people were judging, introducing an inherent confound between affect and the targets of each truth judgment (see Schwarz, 2012). Moreover, feelings elicited by the target itself (*integral affect*) provide valid information; *incidental affect* from another source (e.g., mood, affective prime) can be misleading (see Västfjäll et al., 2016, for a review).

The present work builds off of a large literature showing that affect "bleeds into" judgments, even when it is completely irrelevant. By and large, we make more positive judgments when happy, and more negative ones when sad. After reading about a negative event (e.g., street crime), people give inflated estimates of unrelated risks (e.g., toxic chemical spills); the opposite occurs after reading about a positive event (Johnson & Tversky, 1983). Affect can literally make mountains out of molehills: People in sad moods estimate that hills are steeper (Riener, Stefanucci, Proffitt, & Clore, 2011). Mood (cued by weather) even shapes real-world decisions, such as medical school admissions (i.e., applicants receive lower scores on rainy days; Redlmeier & Baxter, 2009) and stock market investments (i.e., market goes up when the sun shines; Hirshleifer & Shumway, 2003).

Affect is just one of several extraneous cues used when evaluating information – we are prone to the *lure of seductive details*. Explanations of psychological phenomena (e.g., attentional blink) appear more compelling when they include logically irrelevant neuroscience (e.g., brain scans; Weisberg, Keil, Goodstein, Rawson, & Gray, 2009). Similarly, including a picture (e.g., of a windmill in an unidentifiable field) alongside a claim (e.g., *The first wind mills were built in Persia*) makes it seem truer (i.e., *truthiness*; Newman et al., 2012; but see Michael, Newman, Vuorre, Cumming, & Garry, 2013). The present work manipulates the emotional content of accompanying pictures (not the presence or absence of a photograph). The most obvious prediction is that extraneous positive (negative) information cues truth (falseness). Unkelbach and colleagues (2011) noted initial evidence for this hypothesis: Participants judged positive statements to be "true" more often than negative ones in some, but not all, experiments.

If we do judge truth through "rose-tinted glasses," such a positivity bias should increase across the lifespan (see Mather, 2015, for a review). According to socioemotional selectivity theory, older adults sense that "time is limited" and thus strive to maintain important relationships (Carstensen, 1992; Fredrickson & Carstensen, 1990), leading them to interact with fewer peripheral social partners (English & Carstensen, 2014). They also regulate their own affect: In what is considered the "bright side of aging," older adults preferentially remember positive words (Kensinger, 2008), pictures (Charles, Mather, & Carstensen, 2003), faces (Grady, Hongwanishkul, Keightley, Lee, & Hasher, 2007), advertisements (Fung & Carstensen, 2003), and interpersonal impressions (Cassidy & Gutchess, 2012) relative to neutral ones (i.e., *positivity effect*; Mather & Carstensen, 2005). Young adults often demonstrate the reverse: a negativity effect. A recent meta-analysis (N = 7,129) confirmed that older adults exhibit a small, but significant, positivity effect (d = .13) in attention and memory, whereas young adults exhibit a negativity effect (d = -.12; Reed, Chan, & Mikels, 2014). Thus, a positivity bias for truth may be enhanced in old age, while a negativity bias for falseness may only be apparent in young adults.

In three experiments, we asked whether people conflate positivity with truth (and negativity with falseness). Young (Experiments 6-8) and older (Experiment 8) participants judged the truth of claims paired with negative, neutral, and positive faces. These photographs did not bear on the correct answers, so affect served as a completely extraneous cue.

4.1 Experiments 6 and 7

4.1.1 Method

4.1.1.1 Participants

Fifty-four workers (23 female; *M* age = 34.11 years) on Amazon Mechanical Turk (MTurk) participated for compensation in Experiment 6. Fifty-two workers (28 female; *M* age = 39.02 years) participated in Experiment 7.

4.1.1.2 Design

These experiments manipulated affect (negative, neutral, positive) within subjects.

4.1.1.3 Materials

We selected 48 facts from Tauber and colleagues' (2013) general knowledge norms that were likely to be unknown (on average, answered correctly by 1% of norming participants), then generated an additional 42 items of similar difficulty. We converted half of the facts (e.g., *The smallest insect species is the fairyfly*) into false statements by referring to plausible, but incorrect, alternatives (e.g., *The smallest insect species is the adelgid*). Pilot participants could not discriminate between true and false items. We divided the statements into three sets of 30 items.

We collected 90 photographs from FACES, a database of naturalistic facial expressions (Ebner, Riediger, Lindenberger, 2010). They corresponded to 30 individuals each displaying positive (happiness), neutral, and negative (anger in Experiment 6, fear in Experiment 7). Half of the pictured individuals were female, and they ranged in age (19-78 years). Each set of 30 photos (positive, neutral, negative) was paired with a set of 30 statements, with affect counterbalanced across participants.

4.1.1.4 Procedure

After giving informed consent, participants rated 90 statements for truthfulness, using a scale from 1 (*definitely false*) to 6 (*definitely true*). Each statement appeared with a photograph of a negative (angry in Experiment 6, fearful in Experiment 7), or neutral, or happy face (see Figure 5). Participants received a warning that some statements were true and others false. They expected to see pictures, but did not get any further instructions about how to use the photos. We were careful not to insinuate that the pictured individuals were the *sources* of the statements. After all, it is adaptive to think twice about information delivered by a person wearing a frown. Emotions signal approach/avoid behaviors, and thus automatically inform our impressions of whether people are trustworthy (see Todorov, Said, Engell, & Oosterhof, 2008, 2011).

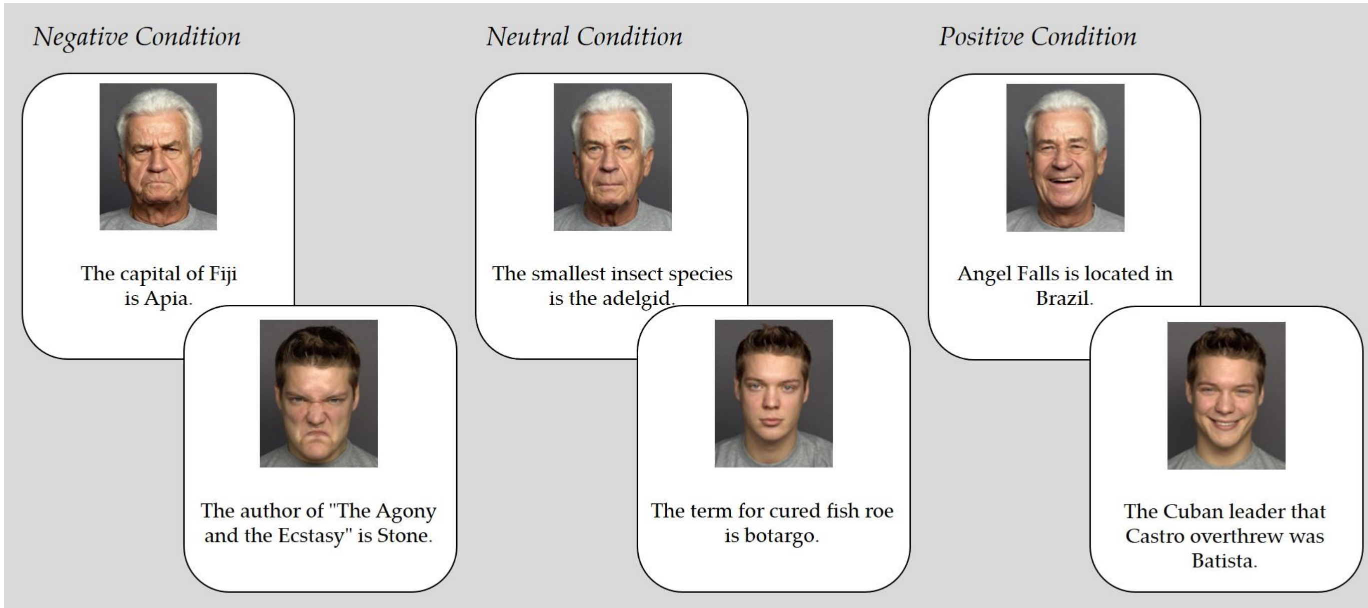

Figure 5: Claims appeared alongside individuals making angry, neutral, and happy expressions in Experiment 6.

4.1.2 Results

The alpha level for all statistical tests was set at .05. Analyses collapsed across true and false statements, since they were indistinguishable to participants. Planned comparisons tested whether each emotion condition (positive, negative) differed from the neutral condition. Conceptually, these analyses improve upon Student's *t*-tests, where sample means are compared to known values. Rather than assuming a "neutral baseline" in the middle of the scale (i.e., 3.5), we actually measured truth ratings of claims paired with neutral faces.

We conducted one-way ANOVAs (affect: negative, neutral, positive) on participants' truth ratings, as well as paired-samples *t*-tests that separately compared each emotional condition (positive, negative) to the neutral condition. The relevant data appear in Figure 6. Main effects of affect emerged [Experiment 6: $F(1.52, 80.48) = 4.40$, $p = .024$, $\eta_p^2 = .08$; Experiment 7: $F(2, 102) = 3.71$, $p = 0.028$, $\eta_p^2 = .07$]. Claims paired with negative faces (Experiment 6: $M = 3.66$, $SD = 0.48$; Experiment 7: $M = 3.50$, $SD = 0.44$) received lower truth ratings than those paired with neutral faces (Experiment 6: $M = 3.79$, $SD = 0.42$; Experiment 7: $M = 3.64$, $SD = 0.39$) [Experiment 6: $t(53) = 2.56$, $p = .013$; Experiment 7: $t(51) = 2.05$, $p = .045$]. However, participants assigned similar truth ratings to claims paired with happy (Experiment 6: $M = 3.84$, $SD = 0.47$; Experiment 7: $M = 3.68$, $SD = 0.47$) and neutral faces, ts < 0.92, ps $> .360$.

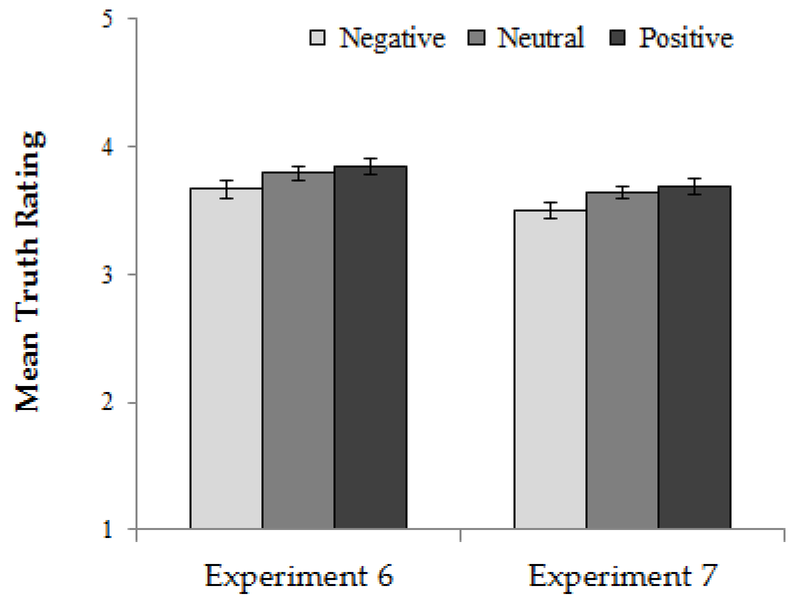

Figure 6: Mean truth ratings as a function of affect in Experiments 6 and 7. Error bars reflect standard error of the mean.

4.1.3 Discussion

Experiments 6 and 7 tested the assumption that positivity inflates perceived truth. Participants saw the same individuals displaying each emotion; this approach controls facial characteristics (e.g., width-to-height ratio) that impact perceived trustworthiness (Costa, Lio, Gomez, & Sirigu, 2017), across conditions. Surprisingly, claims paired with happy faces did not seem truer than those accompanied by neutral faces. Instead, participants exhibited a *negativity heuristic*; presenting a statement like *The cosmonaut who completed the first orbit of Earth was Gagarin* alongside an angry (Experiment 6) or fearful (Experiment 7) face made it seem less truthful. This bias offset participants' consistent tendency to lean toward guessing that a claim is true, in the absence of any other information (neutral baseline *M*s = 3.64 – 3.79). Notably, it is unlikely that participants inferred on their own that the pictured individuals were the *sources* of the claims – otherwise we would see an effect of positive faces (happiness correlates with trustworthiness; Hehman, Flake, & Freeman, 2015; Oosterhof & Todorov, 2009). Experiment 8 assessed whether a positivity bias emerges in old age, when people regulate their emotions by directing their attention to positive (and away from negative) information. The socioemotional selectivity framework predicts that older adults' truth judgments will reflect incidental positive information.

4.2 Experiment 8

4.2.1 Method

4.2.1.1 Participants

Forty Duke University undergraduates (25 female; 18 - 22 yrs) participated for course credit. Forty-five community-dwelling older adults (26 female; 66 - 82 yrs) participated for monetary compensation. We also excluded an older adult who reported misunderstanding the truth rating scale.

4.2.1.2 Design

This experiment had a 2 (age: young, older) x 3 (affect: negative, neutral, positive) design. Affect was manipulated within subjects.

4.2.1.3 Materials

We used the same statements and pictures as Experiment 6. People preferentially recognize faces of same-age peers (i.e., *own-age bias*; see Rhodes & Anastasi, 2012, for a meta-analysis). To avoid any biases in truth ratings, equal numbers of young, middle-aged, and older adults appeared in the photographs.

We included measures that would help us better understand a positivity bias in older adults. Participants estimated their subjective age by clicking on a line labeled "1" to "120" years (Hughes, Geraci, & De Forrest, 2013). The *future time perspective scale* (Carstensen & Lang, 1996) included 10 statements describing perceptions of time horizons (e.g., *I have the sense time is running out*). We did not find a positivity effect in either age group, so these measures will not be discussed further.

4.2.1.4 Procedure

The procedure was identical to that of Experiments 6 and 7, with the exception that older adults also (a) indicated their subjective age and (b) completed the future time perspective scale using a scale from 1 (*very untrue*) to 7 (*very true*) scale.

4.2.2 Results

Again, analyses collapsed across true and false statements. Planned comparisons tested whether each emotion condition (positive, negative) differed from the neutral condition.

We conducted a 2 (age: young, older) x 3 (affect: negative, neutral, positive) ANOVA on participants' truth ratings. Within each age group, we conducted paired-samples *t*-tests on participants' truth ratings, separately comparing each emotional condition (happy, angry). The relevant data appear in Figure 7. The two-way interaction was not significant, $F(1, 83) = 1.84$, $p = .179$. However, the pattern of means suggested important age differences. Post-hoc one-way ANOVAs (affect: negative, neutral, positive) revealed a main effect of affect for young [$F(1.64, 63.89) = 6.38$, $p = .005$], but not older [$F(2, 88) = 1.03$, $p = .362$], adults. According to planned comparisons, young adults perceived claims paired with angry faces ($M = 3.54$, $SD = 0.51$) to be less truthful than those paired with neutral faces ($M = 3.74$, $SD = 0.38$), $t(39) = 2.74$, $p = .009$. They assigned similar truth ratings to claims paired with happy ($M = 3.86$, $SD = 0.37$) and neutral faces, $t(39) = 1.42$, $p = .162$. Older adults, on the other hand, perceived claims paired with angry ($M = 3.44$, $SD = 0.47$), neutral ($M = 3.45$, $SD = 0.47$), and happy faces to be similarly truthful ($M = 3.54$, $SD = 0.45$), ts < 1.23, ps $> .226$.

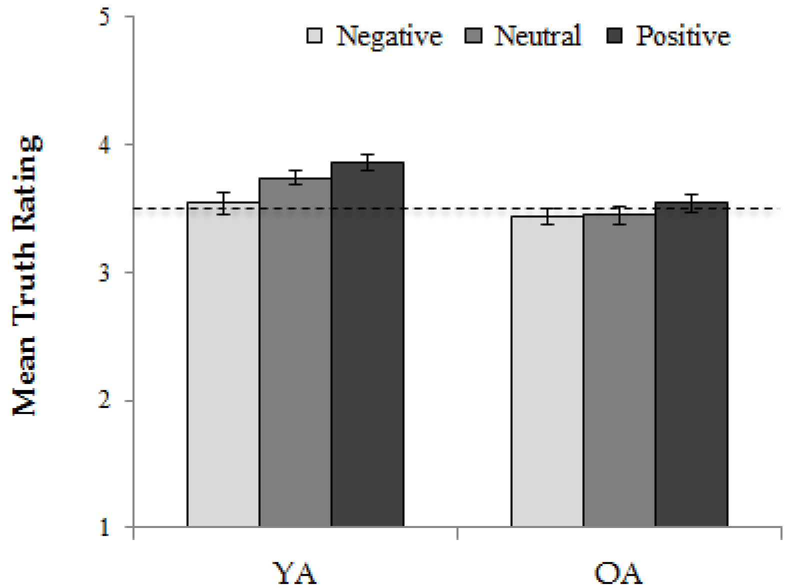

Figure 7: Mean truth ratings as a function of aging and affect in Experiment 8. Error bars reflect standard error of the mean. Dotted line indicates the middle of the scale. YA = young adults; OA = older adults.

To quantify the general bias to respond "true," we compared each age group's mean truth ratings in the neutral condition (young adult $M = 3.74$; older adult $M = 3.45$) to a test value of 3.5 (i.e., the middle of the scale, indicated by a dotted line in Figure 7). Predictably, young adults exhibited a discernible bias to call information "true," $t = 3.99$, $p < .001$. Older adults assigned truth ratings objectively, with no such bias, $t = 0.79$, $p = .435$.

4.2.3 Discussion

The present research tested the idea that people misinterpret positivity as evidence of truth. A continuously cumulating meta-analysis (Braver, Thoemmes, &

Rosenthal, 2014) confirmed that young adults did not infer truth from positivity (Z = 1.63, p = 0.102, 95% CI [-0.01, 0.14]), though the means trended in that direction. Across three experiments and two negative emotions (fear, anger), young adults exhibited the opposite pattern: Claims paired with negative faces seemed less true than those paired with neutral faces. Notably, this negativity bias emerged in the absence of a stable mood (participants viewed a mix of positive, neutral, and negative faces).

Affect serves as the basis for many judgments (i.e., direct inferences), but it also tells us about our environments (Schwarz, 2012). Positive mood implies that we are in a benign, familiar environment, where typical approaches to a problem probably work. Negative mood signals a challenging new environment, and therefore inhibits "situationally dominant thinking styles" (p. 220, Hunsinger, Isbell, & Clore, 2012). In the case of truth judgments, irrelevant positive and negative information "tunes" processing by either maintaining or inhibiting our *truth bias* (Gilbert, 1991). Across experiments, young adults tended to call claims "true" when they appeared alongside neutral, but not negative, faces.

These findings complement a larger literature showing that negative affect is adaptive (see Forgas, 2013, for a review). Popular culture is preoccupied with happiness, but negative moods reduce memory errors (Storbeck & Clore, 2011), encourage fairness (Tan & Forgas, 2010), reduce reliance on stereotypes (Bless & Fiedler, 2006), and decrease social judgment biases (e.g., fundamental attribution error; Forgas, 1998). Negative mood also reduces gullibility and helps us spot liars (Forgas & East, 2008). The current experiments suggest that, more broadly, negative information disengages people from their general bias to call things “true.”

Surprisingly, older adults made rational judgments, unmoved by either positive or negative faces. They did not exhibit a bias to say “true,” contrary to suppositions that older adults are *most* vulnerable to the truth bias (p. 105, Mutter et al., 1995). In other words, there was no judgment bias for negative affect to reverse. More generally, concerns that older adults struggle to inhibit incidental positive affect (e.g., Mikels, Shuster, & Thai, 2015) appear to be misplaced. The current findings serve as another useful counterpoint to the socioemotional selectivity framework. This theory fails to explain emotional well-being in old age – limited future time perspective in a large sample (N = 2,504) predicts a maladaptive emotional profile, including *fewer* positive emotions (Grühn, Sharifian, & Chu, 2016). Moreover, the positivity effect emerges inconsistently (e.g., Steinmetz, Muscatell, & Kensinger, 2010) and may actually reflect a reduced negativity effect in old age (Grühn, Smith, & Baltes, 2005; see Murphy & Isaacowitz, 2008, for meta-analysis). In line with this idea, losses (of time or money) are less salient in old age (Strough, Scholsnagle, & DiDonato, 2011), so older adults fall prey to the *sunk cost fallacy* less often than young adults do; rather than “stick out” a bad movie, they make the rational choice and walk out (Strough, Mehta, McFall, & Schuller, 2008).

More broadly, our results complement the counterintuitive finding that older adults selectively focus on important (and ignore extraneous) information. They are less prone to the *attraction effect*, where adding a third (irrelevant) choice (e.g., strawberry ice cream) alters preferences between two original options (e.g., vanilla and chocolate ice cream; Tentori, Osherson, Hasher, & May, 2001). Whether earning extra credit for a course or grocery shopping, older adults make more consistent choices than young adults do (Kim & Hasher, 2005). Similarly, adding an irrelevant smiling or frowning face to a claim does little to persuade them. This is striking, given older adults well-documented *inhibitory deficit* (Hasher & Zacks, 1988).

Attempts to swindle older adults often involve emotional appeals. The Federal Trade Commission recently challenged phony sweepstakes offers and fraudulent computer technical support services exploiting seniors. Here, the positive (prize) and negative ("cyberthreats") information directly bear on the decisions to pay fines or purchase malware software, respectively. Ancillary emotional information (e.g., a smiling, attractive face next to an anti-wrinkle cream) is less likely to work.

5. Conclusion: Theoretical and Practical Implications[1]

A lie is more comfortable than doubt, more useful than love, more lasting than truth. – Gabriel García Márquez

5.1 Theories of Truth

The present research confirms that cues other than fluency impact perceived truth: knowledge and affect *reduce* illusions of truth. Knowledge can offset the tendency to make fast, fluent responses in some cases, while affect mitigates the general bias to call claims "true." Schwarz, Newman, and Leach (2015) outline the "Big 5" critera for truth assessment (consensus, compatibility with prior beliefs, coherence, supportive evidence, source credibility) and argue that fluency enhances each criterion. For example, participants exposed to a claim several times guess that it comes from a high credibility source (Consumer Reports) rather than a low credibility source (National Enquirer; Fragale & Heath, 2004). By this account, fluency often "hijacks" all other cues for truth. Moreover, knowledge is cast as a mere moderator (Schwarz, 2018), rather than a key player in its own right, and affect behaves as a synonym for fluency. Across studies, knowledge explained the most variance in truth judgments (in some cases, four times more variance than fluency). Additionally, affect was *not* redundant with fluency

[1] Some of these ideas will contribute to Brashier, N. M., & Marsh, E. J. (invited review in preparation). Separating facts from fiction: Heuristics for truth. *Annual Review of Psychology*.

(otherwise positivity would have cued truth), but exerted an independent influence on perceptions of truth.

The impact of negative mood highlights another key insight: Gilbert's (1991) truth bias appears to be neither as large nor as ubiquitous as originally thought. Across experiments, young adults showed a subtle tendency to say "true," a bias that was easily reversed by irrelevant negative information – this was apparent even in the absence of a stable mood, when negative faces appeared amid positive and neutral ones. Older adults' bias was substantially smaller than that of young adults in some experiments, and completely missing in others.

5.2 Theories of Cognitive Aging

This unanticipated finding points to the importance of a lifespan perspective when conceptualizing truth and other judgments. The literature documenting older adults' judgment and decision biases is surprisingly "thin" (Strough, Karns, & Schlosnagle, 2011; see also Peters, Finucane, MacGregor, & Slovic, 2000), perhaps reflecting the belief that they simply over-rely on heuristics used in youth (see Klaczynski & Robinson, 2000). In actuality, older adults *selectively* use deliberative strategies. With age, the perceived and actual costs of cognition increase (Hess, Smith, & Sharifian, 2016) and intrinsic motivation to engage in demanding cognitive processes declines (see Hess, 2014). Whether assigning guilt to accused criminals or evaluating consumer products, older adults use complex cues as often as young adults do. Rather, older adults engaged by the judgment tasks consider complex information more often than same-age peers who report less engagement, a *selective engagement effect* that is smaller in young adults (Hess, Leclerc, Swaim, & Weatherbee, 2009).

External motivators like accountability (Hess, Germain, Swaim, Osowski, 2009) and monetary incentives (Touron & Hertzog, 2009) disproportionately encourage older adults' use of effortful memory strategies. Relative to young adults, older adults exhibit an equal or larger memory benefit for "high-value" items associated with bigger monetary rewards (i.e., *value-directed remembering*; Castel, Benjamin, Craik, & Watkins, 2002; Castel et al., 2011; Castel, Murayama, Friedman, McGillivray, & Link, 2013). Intriguingly, older adults appear to be intrinsically motivated to accurately judge truth, as they spontaneously search memory in a way that young adults do not.

Intrinsic motivation may also explain the absence of a positivity effect for truth judgments. When the stakes of a decision are high, the positivity effect is smaller. For example, older adults disproportionately seek positive information when making health-related decisions (Löckenhoff & Carstensen, 2007), but this bias is reduced among older adults in poor health (English & Carstensen, 2015). In other words, older adults may strategically ignore affective information when making truth judgments because accuracy is important to them. They may be misled instead by extraneous information that appeals more directly to their social goals – pairing claims with pictures of older adults' grandchildren, for example, may sway them.

In sum, older adults make more informed, rational truth judgments than their young counterparts. These findings suggest that it is misguided to assume older adults' deficits and "work backwards" to the mechanisms of suggestibility and credulity. Asp and colleagues (2012), for example, found that patients with focal lesions to the vmPFC bought into misleading advertisements at a higher rate than controls. They selected this patient population as a corollary to healthy aging, based off of the presupposition that older adults are "disproportionately vulnerable to fraud." Instead, the Federal Trade Commission (2018) recently revealed that young adults are twice as likely to be victims of fraud (20s; 40% of complainants) than older adults (70+ years; 18%). Logically, then, strategies designed to prevent misconceptions should focus first on young adults. Simply viewing unrelated negative images or asking yourself *Is this true?* and retrieving relevant facts from memory prove effective. Many other enticing strategies fail (e.g., warnings, "false" labels).

5.3 Preventing and Correcting Misconceptions

The proliferation of misinformation has urgent consequences. False beliefs can harm health in disastrous ways (e.g., measles outbreaks due to lower vaccine compliance; Majumder, Cohn, Mekaru, Huston, & Brownstein, 2015); conspiracy theories about secret government plots and schemes reduce voting intentions (Jolley & Douglas, 2014) and even lead to violence (e.g., a man discharging a rifle in a restaurant while investigating "Pizzagate"); scams incur significant financial losses (median of

$1,092 for older and $400 for young victims; Federal Trade Commission, 2018); and dishonesty in politics goes unpunished (e.g., Donald Trump won the 2016 election despite a *dishonesty gap* – only 15% of his statements were "true" or "mostly true," compared with 51% of Hillary Clinton's).

Preventing misconceptions from taking hold is ideal, as it is notoriously difficult to correct them later. A recent meta-analysis demonstrated that misinformation often persists in the face of debunking messages (Hedges' *d*s = 0.75-1.06; Chan, Jones, Jamieson, & Albarracín, 2017). As examples, retractions do not reduce the false beliefs that vaccines cause autism (Newport, 2015) or that American forces uncovered weapons of mass destruction (WMDs) in Iraq (Newport, 2013). This *continued influence effect* reflects the under-recruitment of right precuneus, a region implicated in encoding source, while processing retractions (Gordon, Brooks, Quadflieg, Ecker, & Lewandowsky, 2017). People can correct myths (e.g., *Playing Mozart can improve a baby's intelligence*, *Liars give themselves away with physical "tells"*) in the short term but struggle to do so at a delay, particularly in old age (Swire, Ecker, & Lewandowsky, 2017).

That said, the way that misinformation initially enters the knowledge base has implications for correcting errors later. Most obviously, it is best to *replace rather than repeat*. Repeating false claims in order to dispute them (e.g., in myth-versus-fact format) renders them fluent and leaves people thinking "I've heard that before, so there's probably something to it" (Lewandowsky, Ecker, Seifert, Schwarz, & Cook, 2012, p. 115).

Recent work suggests that explicitly repeating misinformation once can be safe (Ecker, Hogan, & Lewandowsky, 2017), but additional repetitions may backfire and increase the original false belief (e.g., strengthen the association between *vaccines* and *autism*; but see Wood & Porter, in preparation).

Next, retractions and corrections should not take background knowledge for granted, at least if their audience includes young adults. For better or worse, titles shape our understanding of later content (Bransford & Johnson, 1972; Ecker et al., 2014). A powerful title that "activates" relevant schemas or facts, or draws clear analogies, should preface corrections. Structuring recommendations in this way should make them more memorable and actionable – two factors that push people from believing a recommendation to following it (Ratner & Riis, 2014).

Finally, fearmongering is unlikely to be persuasive, since irrelevant negative information *lowers* young adults' truth ratings. For example, presenting parents with photos of children stricken with measles ironically *increases* their belief that vaccines cause autism (Nyhan, Reifler, Richey, & Freed, 2014). Our results suggest that adding a "positive sheen" to corrective information instead (e.g., presenting photographs of healthy children playing) should have no effect, regardless of the audience's age.

5.4 Moving Forward

Multinomial models that pit two processes against one another (e.g., fluency vs. knowledge, Fazio et al., 2015; fluency vs. recollection, Unkelbach & Stahl, 2009) are informative, but eventually the field should consider how people weight three or more simultaneous cues. Such an approach need not be more complex, since *take-the-best* and *tallying heuristics* can outperform multiple regression (Czerlinski, Gigerenzer, & Goldstein, 1999). As an example, the more recent *referential theory* of illusory truth moves past fluency, and instead asserts that we infer truth from coherent references for statements in memory (Unkelbach & Rom, 2017). This perspectives makes room for additional cues (e.g., retrieval of relevant knowledge) and belief biases. However, a theory based on memory phenomena predicts worse performance among older adults, given their well-documented event memory deficits. Instead, knowledge and experience leave older adults *less* vulnerable to illusions of truth, pointing to the importance of a lifespan perspective. For example, older adults may be particularly likely to "take the best" cue, since they consider less information (Meyer, Russo, & Talbot, 1995) and prefer fewer options (Reed, Mikels, & Simon, 2008) when making decisions. In a "post truth" world, it is crucial to understand the many factors that lend information credibility, as well as how these cues change with age.

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Wood, T., & Porter, E. (in preparation). The elusive backfire effect: Mass attitudes' steadfast factual adherence. doi:10.2139/ssrn.2819073

Biography

Born

August 3, 1990 in Bad Tölz, Germany

Education

Duke University
Ph.D., Psychology & Neuroscience, 2018
Certificate in College Teaching, 2018
M.A., Psychology, 2015

Davidson College
B.S., Psychology, 2012

Publications

Brashier, N. M., & Multhaup, K. M. (2017). Magical thinking decreases across adulthood. *Psychology and Aging*, *32*, 681-688. doi:10.1037/pag0000208

Brashier, N. M., Umanath, S., Cabeza, R., & Marsh, E. J. (2017). Competing cues: Older adults rely on knowledge in the face of fluency. *Psychology and Aging*, *32*, 331-337. doi:10.1037/pag0000156

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Marsh, E. J., Cantor, A. D., & **Brashier, N. M.** (2016). Believing that humans swallow spiders in their sleep: False beliefs as side effects of the processes that support accurate knowledge. *Psychology of Learning and Motivation*, *64*, 93-132. doi:10.1016/bs.plm.2015.09.003

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Honors and Awards

2017 American Psychological Association Dissertation Research Award, $4,114
2017 American Psychological Foundation 125th Anniversary Scholarship, $3,000
2017 Functional Magnetic Resonance Imaging Training Fellowship (*University of Michigan*)
2017 Phillip Jackson Baugh Fellowship (*single award to promote a Duke student's career in aging and human development*), $30,882
2016 Kavli Summer Institute in Cognitive Neuroscience Fellowship (*UC Santa Barbara*)
2015 Summer Institute on Bounded Rationality Fellowship (*Max Planck Institute*)
2012 National Science Foundation Graduate Research Fellowship, $134,000