Children's beliefs about search engines.

Lauren N. Girouard-Hallam
University of Louisville

Follow this and additional works at: https://ir.library.louisville.edu/etd

Part of the Cognitive Psychology Commons, Cognitive Science Commons, and the Developmental Psychology Commons

Recommended Citation
https://doi.org/10.18297/etd/4307

This Doctoral Dissertation is brought to you for free and open access by ThinkIR: The University of Louisville's Institutional Repository. It has been accepted for inclusion in Electronic Theses and Dissertations by an authorized administrator of ThinkIR: The University of Louisville's Institutional Repository. This title appears here courtesy of the author, who has retained all other copyrights. For more information, please contact thinkir@louisville.edu.
CHILDREN’S BELIEFS ABOUT SEARCH ENGINES

By

Lauren N. Girouard-Hallam
B.S., Furman University, 2017
M.A., New York University, 2019
M.S., University of Louisville, 2021

A Dissertation Submitted to the Faculty of the
College of Arts and Sciences of the University of Louisville
in Partial Fulfillment of the Requirements
for the Degree of

Doctor of Philosophy
in Experimental Psychology

Department of Psychological and Brain Sciences
University of Louisville
Louisville, Kentucky

May, 2024
CHILDREN’S BELIEFS ABOUT SEARCH ENGINES

By

Lauren N. Girouard-Hallam

A Dissertation Approved on

March 26th, 2024

by the following Dissertation Committee

______________________________
Judith Danovitch
Dissertation Director

______________________________
Nicholaus Noles

______________________________
Sara Bufferd

______________________________
Lauren Myers
DEDICATION

I would like to dedicate this dissertation to my father, Nicholas David Girouard, who passed away on January 19th, 2004. My dad was the best of all things: nurturing, funny, and creative. Before he died, he’d started talking about the possibility of going to college, something he never had the chance to do. So, I did it for him, again and again, until I reached this moment. This is for him.
ACKNOWLEDGEMENTS

I would like to first thank my exceptional mentor, Dr. Judith Danovitch, for her unwavering guidance and support. I came to the University of Louisville, like so many first-generation students, uncertain of what exactly I was about to undertake and of my own abilities to thrive in academia. Her belief in my ability to not only achieve my goals, but excel in them, manifested in the great deal of time, care, and effort she put into making me a better writer, academic, and person. Judith will always be not only my mentor, but my collaborator and colleague, and I look forward to enjoying many more years of scientific inquiry together. I would also like to thank my committee members Dr. Nicholaus Noles, Dr. Sara Bufferd, and Dr. Lauren Myers for their role in shaping this dissertation and their willingness to serve as members of my committee. I would also like to thank Dr. Christian Stilp and Dr. Marci DeCaro for their mentorship, encouragement, and steadfast belief that I could do this. Finally, I would like to thank Dr. Victoria Turgeon and Will Lowry, my earliest academic mentors at Furman University, who indelibly shaped my academic identity and continue to provide guidance, support, and friendship.

I would like to thank my mother, Carol Girouard, who encouraged me to continue learning for as long as I loved doing so, and believed in me even when it was difficult for me to believe in myself. My mother was my first ever Editor-in-Chief and Reviewer 2. She could tell whether I had enjoyed writing a school essay or not based on the quality of
my work, and my work was always better simply because she took the time to read it. I know she will be able to tell how much I truly enjoyed writing this.

I would also like to thank Megan Norris, my lifelong collaborator and best friend, for every writing marathon, study assist, and gossip session. Late nights and early days were always better because of you. I would also like to thank Allison Williams, Khushboo Patel, Hannah Schroeder, and Kate Aubuchon, for their friendship, clear-headed advice, and mutual support. I am lucky to be surrounded by incredible academics. I am also lucky to be surrounded by friends outside of academia who nurtured and supported my ambitions, checked-in with me, lent shoulders and ears when required, and generally kept me moving forward. For these reasons and so many more, I owe my gratitude to Taylor Jensen, Chelsea and Tim Schaffer, Makayla Swygert, and Katie and Lynn Fleet.

I must also extend my deepest gratitude to my wife, Madison Girouard-Hallam. I don’t quite have the words for the role that Madison has served these past eight years. She has weathered multiple moves to new parts of the country, all manners of academic rejections, and my dissertation process with so much gentleness and grace and love. She has celebrated every milestone, big and small, and fueled me when my own energy for this process ran low. She has loved me through highest highs and lowest lows, and perhaps most importantly, she has reminded me to take breaks, rest, and enjoy this wonderful, colorful life that we share. This dissertation would not have been possible without her.

I would like to thank Sacred Heart Preschool, Keneseth Israel Preschool, and Adath Jeshurun Preschool for their support in allowing me to collect data for my
dissertation. A special thank you to Children Helping Science for four years of steady and reliable online data collection in the face of massive change and instability during the COVID-19 pandemic and after, and to Hwang’s Martial Arts Studio for allowing me to run my studies at not just one, but three, of their after school care locations. I would like to thank the undergraduate research interns who contributed to the various parts of this project, and generally made coming into lab each day a joy and an adventure. I would like to thank the undergraduate research interns who patiently entered hundreds of lines of data, called dozens of families and emailed many more, particularly Hailey Streble, Rachel Archer, Ethan Bailey, and Lou Holm, who worked closely with me on many projects, including these.

I would like to echo Megan Norris’ sentiment that it takes a village to graduate from a PhD program and complete a dissertation. I am grateful for everyone who has played a role in my academic journey, from my brilliant rescue pup, Molly, who is my favorite coworker, to Madison’s parents, Emma and Jeff, and grandparents, Sherry and Greg, who always provided a soft place to land. My cup overflows with gratitude to you all.
ABSTRACT

CHILDREN’S BELIEFS ABOUT SEARCH ENGINES

Lauren N. Girouard-Hallam

March 27th, 2024

Children rely on information from other sources to think and learn about the world around them. As the world around them digitizes, their options for where to seek new information have expanded to include technological sources like Google Search. This dissertation examines what factors impact children’s trust in search engines, particularly Google. In the first set of studies, 4- to 8-year old children were asked whether technological informants and a teacher could answer stable and changing questions, and which informant would have the better answer. With age, children endorsed the Google search engine at higher rates and the teacher at lower rates. In addition, children’s perceptions of informant familiarity play a role in these judgments. Children endorsed Google and the Internet at higher rates than they endorsed a teacher or an unfamiliar search engine. The next set of studies expands upon these findings by examining children’s intuitions with an older sample (7- to 10-year old children) and including past, present, and future event questions. With age, children’s endorsements of Google increased and their endorsements of the teacher decreased for current event questions (i.e., questions about events happening today), but stayed stable for questions about the past (i.e., events that happened yesterday). These findings were replicated even when children were told about events happening “right now” instead of “today” and related to
children’s attitudes about the Internet at large. Across these four studies, children’s intuitions about search engines changed with development, including the kinds of cues children pay attention to in order to make decisions about which informants to trust.
TABLE OF CONTENTS

DEDICATION .................................................................................................................. iii
ACKNOWLEDGEMENTS .............................................................................................. iv
ABSTRACT .................................................................................................................... vii
LIST OF TABLES ............................................................................................................ x
LIST OF FIGURES ........................................................................................................ xi
CHAPTER I .................................................................................................................... 1
CHAPTER II ................................................................................................................. 8
CHAPTER III ............................................................................................................... 49
CHAPTER IV ............................................................................................................... 80
REFERENCES ............................................................................................................. 87
CURRICULUM VITAE ............................................................................................... 104
# LIST OF TABLES

<table>
<thead>
<tr>
<th>TABLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chapter 2:</strong></td>
<td></td>
</tr>
<tr>
<td>Table 1. Item lists for Study 1 and Study 2</td>
<td>17</td>
</tr>
<tr>
<td>Table 2. Omniscience Model Teacher Interaction Statistics</td>
<td>31</td>
</tr>
<tr>
<td>Table 3. Technological Informant Model Statistics</td>
<td>35</td>
</tr>
<tr>
<td><strong>Chapter 3:</strong></td>
<td></td>
</tr>
<tr>
<td>Table 1. Study 1 Justification Codes and Examples with Number of Responses Coded in Each Category</td>
<td>55</td>
</tr>
<tr>
<td>Table 2. Justification Coding and Examples for Study 2 with Number of Responses Coded into Each Category</td>
<td>66</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

**FIGURE** | **PAGE**
--- | ---
**Chapter 2:**
Figure 1. Check Question Examples for Study 1 and Study 2 | 15
Figure 2. Predicted Probabilities of Study 1 Omniscience Attributions | 20
Figure 3. Children’s Endorsements of Google and a Teacher by Age | 21
Figure 4. Children’s Endorsements of Google and a Person by Age and Omniscience Judgment | 23
Figure 5. Predicted Probabilities of Omniscience for Study 2 | 30
Figure 6. Children’s Average Omniscience Attributions by Age | 32
Figure 7. Children’s Endorsements of Technology and a Person By Age | 33
Figure 8. Children’s Endorsements of Informants by Question Type | 34
Figure 9. Children’s Endorsements of Technological Informants and a Person by Informant and Age | 36
Figure 10. Children’s Endorsement of Informants by Question Type and Age | 38
Figure 11. Children’s Preference For Technological Informants vs. a Person by Age | 39
Figure 12. Children’s Preference for Technological Informants by Question Type | 40
Chapter 3:

Figure 1. Children’s Endorsements of Google and a Person across Age and by Question Type………………………………………………………………………………..59

Figure 2. Children’s Endorsement of Google and a Person across Age by Question Type………………………………………………………………………………..70

Figure 3. The Proportion of Children Choosing Google across Age by Question Type………………………………………………………………………………..71
CHAPTER I

CHILDREN’S BELIEFS ABOUT SEARCH ENGINES

Young children are citizens of an increasingly developed and complex technological world woven together by the same thread: the Internet. In the United States, 98% of families with children under age 9 can access the Internet at home (Rideout, 2017). Children access the Internet using devices ranging from cellphones, laptops, and tablets, to freestanding smart speakers like Amazon’s Alexa. Moreover, with the advent of voice-activated technology, children’s Internet searches can now begin from the moment children can verbalize a question (Lovato et al., 2019; Oranç & Ruggeri, 2021). The Internet and Internet-based devices provide access to all kinds of information: accurate and inaccurate, current events and historical facts, subjective and objective, private and public. However, little is known about children’s understanding of what kinds of information can be accessed using the Internet and Internet-based devices.

Children increasingly use the Internet to find answers to questions. Children ask questions of information sources both to learn new information and to refine existing beliefs (Coughlin et al., 2014; Frazier et al., 2009; Ronfard et al., 2018; Wellman et al., 2019). American parents believe that navigating the Internet is a valuable skill (Vittrup et al., 2016), and parents will use the Internet with their children to answer their questions (Rideout & Robb, 2020). Children as young as age 4 sometimes independently use Internet-based devices, like tablets, to play games or watch educational videos (Eisen & Lillard, 2017; Rideout & Robb, 2020). By age 7, American children show a preference
for information derived from an Internet-based source over a human source for acquiring general knowledge (Danovitch et al., 2015; Girouard-Hallam & Danovitch, 2022a). However, children may struggle to understand when the Internet can provide accurate answers to questions and when it cannot. By this age, children are even able to discern that the Internet should not be viewed as reliable when it is explicitly inaccurate (Tong et al., 2022). Moreover, children as old as 10 can have difficulty independently identifying misinformation online (Einav et al., 2020). Understanding children’s beliefs about the Internet provides important insight to how they may view other technological informants, such as search engines.

**The Google Search Engine**

Google Search accounted for approximately 91% of the search engine market in 2023 (Statcounter, 2024) and processed 8.5 billion searches per day (Bianchi, 2024). Over 80% of American adults say that they prefer to do their own research when making important life decisions, and the largest proportion of those adults (46%) say that they start their research with an online search (Turner & Rainie, 2020). People turn to Google Search to answer questions about critical topics like health (Gramlich, 2017) and politics (Lam, 2018), and, importantly, they largely believe the information that they receive from Internet search to be accurate and reliable (Purcell et al., 2012).

However, adults do not see Google search and other search engines as infallible. Although most believe Google to be an accurate source of information, 74% of adults are uncomfortable with how much personal information about other people is searchable online (Auxier, 2020) and 65% do not want to have their results personalized for fear that it prevents access to a wider variety of viewpoints or alternative sources of information.
(Purcell et al., 2012). Only 59% of adults in 2012 noticed advertisements in search engine results (Purcell et al., 2012), but 68% said that they did not want ads in their Internet searches. Despite these misgivings, 84% of American adults prefer Google search over other online information sources (Purcell et al., 2012) and most people in the United States use Google at least three times per day (Auxier, 2020).

Adults may be Google’s primary user base, but they are far from its only user base. Children are also using Google to answer questions about the world around them. In fact, in 2012, a survey of British children found that the majority of children ages 6 to 15 used Google to answer questions, and nearly half of these children did so upwards of five times per day. In more recent survey research, American children ages 8 to 18 report using search engines regularly to help with homework or schoolwork (Rideout et al., 2022). Google Search is a broadly used Internet-based tool, and it is therefore of interest to examine children’s trust in search engines.

**Children and Search Engines**

Even though search engines use the Internet in order to function, children may see search engines as different from the Internet. Search engines are not limited by a verbal response, like the kind a smart speaker provides, or even a single website, for the amount of information that they can provide, and they have access to social networking webpages like Instagram, Facebook, or TikTok, that could reasonably provide personal information about other people. Given that American parents encourage their children to use the Internet, and that many adult Americans frequently use Google to search for information (Purcell et al., 2012), children are likely to be familiar with search engines like Google. However, children as old as middle-schoolers may fail to understand how a search engine
works (Kodama et al., 2017), fail to seek information from the right place (Druin et al., 2010), or fail to formulate a question the search engine can reliably answer (Dodge et al., 2011). Just as research has suggested they do with the Internet (Brodsky et al., 2021), children often describe Google as the devices that use it (e.g., a computer), and simplify its processes by describing it as a group of people feeding responses to questions (Kodama et al., 2017). Beliefs about Google’s abilities and functions may also be enforced by children’s behaviors towards Google, such as phrasing their search queries as natural-language questions instead of keyword phrases (Kammerer & Bohnacker, 2012) and focusing their attention on only the top results in a Google search, rather than taking in the full spectrum of information Google provides (Bilal & Gwizdka, 2016).

Children also value an informant’s capacity for direct observations (Nurmsoo & Robinson, 2009). Although people can directly observe phenomena, “Google” cannot. Therefore, in order for children to trust Google as a source of current event information or personal information about others, they need to be able to reason about Google’s capacity not only as a source of information, but as one that can be updated without direct observation and by other people. Thus, despite Google’s broad access to information, children ages 10 and younger may still ascribe narrow capacities to Google.

**Children’s Selective Trust in the Internet**

The kinds of information that children expect to receive from sources of information may vary depending on the source itself. Typically, children learn from human informants, and they do so selectively, based on a variety of characteristics ranging from epistemic qualities like reliability (Pasquini et al., 2007) and accuracy (Harris et al., 2018) to social qualities like confidence (e.g., Brousseau-Liard & Poulin-
Dubois, 2014) and benevolence (e.g., Fusaro et al., 2011; Lane et al., 2013). Children’s preference for accurate sources also extends to computers (Danovitch & Alzahabi, 2013) and smart speakers (Girouard-Hallam & Danovitch, 2022a).

Ultimately, the Internet connects technological devices to the information people seek, so it is important to evaluate children’s understanding of the Internet as the source of the “knowledge” that devices possess. However, children do not have a sophisticated understanding of how the Internet works until at least early adolescence (Brodsky et al., 2021; Yan, 2005, 2006, 2009). This limited understanding may hinder children’s understanding of the kinds of information that Internet-based sources can provide. For example, 4- and 5-year old children are skeptical of the Internet or an Internet-based device’s ability to provide general information more accurately than a teacher (Wang et al., 2019), a book (Eisen & Lillard, 2016), or even hearsay (Danovitch & Lane, 2020), possibly because they have less experience independently interacting with the Internet. Older children’s perception of their ability to navigate the Internet independently (including using the Internet to answer their questions) is positively correlated with their age, but their beliefs about accuracy change in later childhood. Nine- to 10-year-old children also believe that the Internet is less accurate than 6- to 8-year-old children do (Girouard-Hallam et al., 2023). Thus, although children may believe the Internet is capable of providing a wide variety of information (i.e., children ages 6-10 believe the Internet can reliably provide information about past events and science facts), their predictions may also become more selective as children consider what information the Internet can reliably provide.

The Current Project
This dissertation consists of four interrelated studies exploring children’s beliefs about, preferences for, and trust in search engines. The studies include children ages 4-10. This range of ages covers the period from which children first become familiar with technology and can recognize words related to the Internet (approximately age 4-6; e.g., Dodge et al., 2011) to the age at which they begin using technology in school (approximately age 7-8; e.g., Rideout & Robb, 2020) through to the age at which they begin to develop a more sophisticated understanding of the Internet and its intricacies (approximately age 9-10; e.g., Yan, 2005, 2006, 2009). As children develop, they become more sensitive to qualities of informants like accuracy (Harris et al., 2018) and expertise (Aguiar et al., 2014; Lutz & Keil, 2002). Additionally, children’s executive functioning improves, allowing them to think more critically about sources of information (Hermes et al., 2018). These two simultaneous processes have the potential to lead to increasingly selective trust in both human and non-human informants.

The studies in Chapter 2 examine young children’s preference for a technological source (Google) versus an informed adult source (a teacher) for information that changes or always stays the same (Study 1). Chapter 2 also examines children’s beliefs about alternatives to the Google Search engine, including a novel search engine and the Internet at large (Study 2). Chapter 3 extends the findings of the initial pair of studies described in Chapter 2 to examine 7- to 10-year-old children’s evaluations of Google search as opposed to a person for providing past, present, and future information. Two studies explore whether there are developmental changes in children’s understanding of when to trust search engines over people (i.e., that certain kinds of information are better suited for some sources than others). In doing so, these studies consider children’s impressions
of a fundamental feature of technology: its ability to access constantly updated, and even projected, information. Chapter 4 then provides an overview of the implications of the four studies as a whole and suggests future work on children’s intuitions about technology.

Together, the studies in this dissertation address children’s developing intuitions about search engines. The goal of this dissertation is to highlight developmental changes in children’s attitudes towards search engines, in particular examining whether children’s trust in Google search changes or develops with age and the kind of information sought. Although the majority of children’s selective trust research has examined what children believe about human informants’ abilities to answer questions about unchanging general knowledge information, children are growing up in a constantly-changing world fueled by technology. Understanding children’s beliefs about technology’s ability to answer questions about not only general knowledge facts, but changing and developing information impacting the world, provides a more complete picture of children’s trust and their understanding of increasingly common Internet-based tools.
CHAPTER II

“I’VE SEEN GOOGLE BEFORE!”: YOUNG CHILDREN’S INTUITIONS ABOUT
GOOGLE’S QUESTION ANSWERING CAPABILITIES

Google is such a ubiquitous part of our daily lives that “to Google” now means
“to search online.” Google is the world’s most accessed website (Similarweb. 2024), and
by the time they are 7, many American children have conducted a Google search
(Girouard-Hallam & Danovitch, 2022b). Although preschool-age children may not use
Google themselves, the ubiquity of Google means that they may have heard about Google
from adults and older children. Yet little is known about whether preschool age children
believe that Google is a viable informant, and whether that belief is dependent upon their
familiarity with Google and their beliefs about the extent of its knowledge.

Children under age 7 are skeptical of Internet-based sources and tend to prefer
human informants when given the choice between them (Girouard-Hallam & Danovitch,
2022a; Wang et al., 2019). For example, children under 7 are less likely to believe that an
improbable event occurred when testimony about the improbable event comes from the
Internet than from hearsay, a book, or from an unattributed source, but children older
than 7 show the opposite pattern (Danovitch & Lane, 2020). Younger children sometimes
prefer to consult an Internet-based informant for general knowledge information over a
person (i.e., they pick the Internet-based informant in a forced-choice task), but this
preference belies their actions, with these same children endorsing a person’s answers
more frequently than an Internet-based informant’s answers (Girouard-Hallam & Danovitch, 2022b).

One reason that young children may prefer human informants to Internet-based informants is a lack of understanding about the Internet. Even 10- to 12-year-old children can struggle to explain how the Internet (Yan 2005, 2006, 2009) or Google (Kodama et al., 2017) work, instead describing the Internet in terms of the objects that use it, like phones or tablets (Brodsky et al., 2021). In addition, although children recognize that technological devices like cell phones are internally complex (Ahl et al., 2020), much of what children know about the Internet comes from watching their parents troubleshoot physical mechanisms (e.g., wires) of Internet-based devices (e.g., computers, Rücker & Pinkwart, 2016). As technology streamlines and is no longer dependent on visible wires or modems, children may find it increasingly difficult to understand how the Internet works (Mertala, 2019). Moreover, children need to be able to read and write to access websites on traditional Internet browsers and to formulate search queries (Duarte-Torres et al., 2014). Thus, due to lack of both skill and experience, “the Internet” or novel Internet-based devices may be difficult for young children to conceptualize. In contrast, because children often describe the Internet in terms of the things that use it, Google, a tool that uses the Internet, may be easier for young children to understand than the Internet as a whole.

Preschool-age children are also undergoing cognitive changes that may impact their intuitions about Google search. Children in this age group improve in their attentional capacity, which contributes to their judgments about when to trust human informants (Lucas et al., 2013; Stengelin et al., 2018). Theory of Mind also improves in
this age range and is connected to children’s trust in human informants (Celik et al., 2023; Souza et al., 2021; Van Reet et al., 2015). Attention may also be connected to children’s use of and beliefs about technological informants, such that children’s ability to evaluate devices is impacted by their attentional maturity (Dube & McEwen, 2017). Children under 6 are particularly trusting of human informants (Jaswal, 2013), but their skepticism and doubt in human informants increases as they age (Mills, 2013). Thus, as children’s cognitive skills develop, their intuitions about and understanding of Google search may also change.

Children prefer familiar informants over unfamiliar ones (e.g., Corriveau & Harris, 2009). Previous research on children’s trust in Internet-based informants has examined children’s trust in information from the Internet (e.g., Danovitch & Lane, 2020; Wang et al., 2019), which requires children to be able to read and write to use it, or novel voice-assistants (Girouard-Hallam & Danovitch, 2022a) which are, by definition, unfamiliar. It may be that this lack of familiarity impacted children’s responses in these studies. In contrast, Google is likely to be more familiar to children than the Internet or voice-assistants. Google has several “child-friendly” search interfaces, such as Kids Space and Safe Search, which are targeted at children age 5 and up (Fingal, 2022). Google Home has also increased access to Google through voice-to-text search for children as young as 2 (Wilcox, 2018). Even if children have never done a Google search themselves, it is quite possible that they have still heard of Google given its popularity. Because Google was likely to be familiar to child participants, the current study includes a familiar type of human informant as a contrast to Google. A teacher was included as a contrasting human informant in these studies. Teachers are familiar human informants
that children know are generally knowledgeable about the world around them (e.g. Corriveau & Harris, 2009). The current studies therefore examine whether children prefer to ask a knowledgeable human informant (a teacher) or to consult Google search to answer questions.

Studies 1 and 2 also examine whether young children recognize that a Google search is better for answering certain kinds of questions than others. The majority of selective trust research has examined children’s preferences for informants answering questions about factual information that does not change with time (e.g., Hermes et al., 2017; Kinzler et al., 2010; Isella et al., 2019; Bascandziev & Harris, 2016; see Harris et al., 2017 for review). However, much of the information that is accessed online is not stable. For example, information related to the weather, sporting events, election results, popularity metrics, and movie times can all change regularly. One of the strengths of Google is its ability to update what it “knows” more efficiently than a person can (barring the person having direct experience, but it is unclear how well children understand this characteristic). There is some evidence that children recognize that tablets can be used to access current event information, like the weather, by age 6 (Eisen & Lillard, 2016). Additionally, in a study examining 7- to 10-year-old children’s preference for Google search, children more frequently stated that Google could answer questions about current events, and less frequently stated that a person could do so (Girouard-Hallam & Danovitch, 2022b).

Children’s capacity to think about the timeframe of information may also impact their beliefs about Google search. Preschool age children improve their ability to think about time between ages 3 and 5. This includes skills like constructing a mental timeline
of events (Hudson & Mayhew, 2012; Zheng & Hudson, 2011) and thinking about the future (Tillman et al., 2018). Thus, children’s belief that Google can provide current event information may change with age as their ability to think about timeliness concepts becomes more sophisticated. To explore this possibility, the current studies ask children about Google’s and a teacher’s ability to answer questions about both stable and changing information.

Current Studies

Participants in Studies 1 and 2 consisted of 4- to 6-year-old children and 4- to 8-year-old children respectively in order to examine developmental changes in children’s intuitions about Google Search. American children ages 4 to 8 are exposed to the Internet at high rates (Rideout & Robb, 2020) but they are also still acquiring the ability to interact with the Internet and Internet-based devices. Although most of the 4- to 6-year-old participants were likely to have heard of the Internet and Internet-based devices like Google (Dodge et al., 2011; Rideout & Robb, 2020) and to have potentially co-used the Internet with their parents (Vittrup et al., 2016), they were likely less able than the 7- and 8-year old children to formulate their own search queries or use search engines independently (Duarte-Torres et al., 2014).

Children’s familiarity with Google was also expected to increase with age, even within the study of 4- to 6-year-old children. Although age and familiarity with an Internet-based source are often related (e.g., Auxier et al., 2020; Girouard-Hallam et al., 2023; Rideout & Robb, 2023), previous research on Internet-based informants has also suggested that they are not strongly correlated (e.g., Girouard-Hallam et al., 2023). Therefore, we expected both familiarity and age to relate to an increase in children’s
endorsements of Google. Based on prior research indicating that 4- and 5-year-olds show greater trust in stable general knowledge information received from a person than from an Internet-based source (Danovitch & Lane, 2020; Girouard-Hallam & Danovitch, 2022a; Wang et al., 2019), we also anticipated that there would be developmental differences such that younger children would more frequently endorse a person and less frequently endorse Google than older children would.

Finally, we were interested in exploring developmental changes in ascribing omniscience to technological informants and to a teacher, and how these attributions relate to children’s trust in each of these informants. Children under age 6 have difficulty understanding omniscience (Lane et al., 2014). Even when children in this age group are told that someone is omniscient, they often prefer a domain-specific informant (e.g., a doctor) over an omniscient person, or they place limits on an omniscient person’s abilities (e.g., stating that an omniscient person does not know about another person’s internal states). Some young children also ascribe knowledge to the domain-specific informant or a familiar informant (e.g., their mother) that they could not reasonably have. Children may therefore ascribe knowledge to teachers beyond their actual capabilities. Additionally, in recent studies where children were asked to explain why they believed Google could answer different kinds of questions, some children answered that Google knew everything or almost everything (Girouard-Hallam & Danovitch, 2022b). We therefore anticipated that children who believed that the teacher was omniscient would more frequently endorse the teacher and children who believed that Google was omniscient would more frequently endorse Google.

**Study 1**
Methods

This study was pre-registered. The pre-registration can be found at:
https://aspredicted.org/6D9_V47.

Participants

Participants included 120 4- to 6-year old children (Mage = 5.55; range = 4.02-6.99; 59 girls, 61 boys). Eight additional participants were excluded due to inability to pass the check questions, and one was excluded due to experimenter error. Participants completed the study online via a Zoom call (n = 97), in person at their preschool, after school care program, or apartment complex (n = 22), or in a laboratory in Louisville, KY (n = 1). Seventy percent were identified by their parents as White or Caucasian-American, 16% as Asian-American, 2% as Black or African-American, and 7% were identified as belonging to two or more races. An additional 5% of parents did not identify their child’s race. Most participants (90%) were identified as non-Hispanic, 6% were identified as Hispanic, and ethnicity information was not provided for 4% of children. The parents of 78 of the children in this sample were also asked to report parental education and income, as indicators of socioeconomic status (SES). Over half of children in these families (57%) had at least one parent with a graduate degree and over half of children (61%) had families with a household income of $100,000 or greater. Therefore, this sample can be described as largely middle and upper class.

To determine sample size, we performed a two-tail, one sample t-test a priori power analysis in G*Power (Faul et al., 2007) as a proxy for determining level-two group sample size for a multilevel model (see Murayama et al., 2022). We used an effect size value of $d = .35$ (based on effect sizes found in Girouard-Hallam & Danovitch, 2022a).
The group sample size at power = .95 is 110. Thus, our sample size is appropriate to proceed with the planned analyses.

**Materials**

Children viewed images on a computer screen through a powerpoint presentation. Materials can be found here:

https://osf.io/pcrkd/?view_only=2b028c7000e54a74b5eee2226e92a6c8.

**Procedure**

**Introduction and Check Questions.** Children were told that they would talk with the researcher about different kinds of things, some that can change every day, and some that always stay the same. Children were then shown an example of each of these scenarios. In the first, they were told about two people talking about dolphins. One of the people asked the other what color dolphins are. The second person replies that dolphins are grey. The child was then told that the first person asked the second the same question again later, and that the answer did not change because the color of dolphins did not change. Children were then asked if the answer can be different if the first person asked the question again. The second example involved the same sequence, except that the question was about the color shirt someone was wearing, which changed from red to yellow when the question was asked a second time. Children were again asked if the answer can be different if the person asked again. If the child provided an incorrect answer, the target question was re-stated and they were given two additional attempts. Only children who were able to correctly answer both questions in three or fewer attempts were included in the sample.

Figure 1. Check Question Examples for Study 1 and Study 2.
Figure 1: Check question slide images demonstrating how children were introduced to unchanging and changing information, respectively. In the first example, the target question was about the color of a dolphin, which cannot change. In the second example, the target question was about the color of a person’s shirt, which can change.

Additionally, at the conclusion of the study, children were asked which informant was a person and which informant was on a computer. These questions was treated primarily as a listening test. One child incorrectly identified Google as a person and 8 incorrectly identified the teacher as a computer. Excluding these children would not change the pattern of the results so they are included in all analyses.

**Google Introduction.** Children were told that they were going to talk about Google Search. The experimenter introduced Google as follows: “Google is a search engine, which is something that uses the Internet in order to help answer questions. If someone has a question, they can “Google” it! They do this by typing a question into a box, here. After they type in their question, they can press this button, here, that says GOOGLE SEARCH.” The experimenter then presented an example search process for the most popular ice cream flavor in the United States.

**Teacher Introduction.** Children were told they were also going to talk about teachers. The experimenter described a teacher as “a person who knows a lot of things. If someone has a question, they can ask their teacher. They can tell the teacher their
question and the teacher will use their brain to think about the answer.” Children were then shown an example of a teacher thinking about and answering a question about the most popular pet in the United States.

**Familiarity Questions.** To explore children’s familiarity with Google and with a teacher, children were asked if they had ever seen or heard of Google search before, if they had ever used Google search themselves, and if they had ever seen someone else, like a parent or sibling, use Google search. Children were also asked if they had ever seen a teacher before, if they had ever asked a teacher a question before, and if they had ever seen someone else ask a teacher a question. All questions were yes/no questions.

**Endorse Trials.** Children were told that the experimenter would be telling them about people who have a question because they want to know something. Children were instructed to indicate who the third-party person could go to in order to find the correct answer. Children were then presented with a series of ten questions asked by third-party people. Five were about stable general knowledge information and five were about changing information (see Table 1 for full list of items). Questions were designed to contain novel words as opposed to real words, which might prompt children to respond differently based on their level of knowledge of the answer (e.g., children who knew the color of lychee fruit might be more inclined to believe that another person could answer the question). Questions were shown in one of two random orders. After each target question, children were asked if Google could answer the question and if the teacher could answer the question. Children could answer yes or no for each informant.

Table 1. Item lists for Study 1 and Study 2

<table>
<thead>
<tr>
<th>Stable Items</th>
<th>Changing Items</th>
</tr>
</thead>
</table>
Hibble fruits are always the same color inside. Harlow wants to know what color hibble fruits are on the inside.

People in Zombot always speak the same language. Tilly wants to know what language people in Zombot speak.

Lake Modi can always be found in the same place. Tia wants to know what country Lake Modi is in.

Humans always have toma in their blood. Reba wants to know what Toma is made of.

Zazzes are animals that always eat the same food. Judy wants to know what zazzes eat.

Daxes are plants that always grow at the same time of year. Miley wants to know when Daxes grow. (Study 2 only)

Every day, the sun in Pru sets at a different time. Lily wants to know what time the sun will set in Pru today.

Every day, the lights on the Hux tower are a different color. Pam wants to know what color the lights on the Hux tower are today.

Every day, different types of flowers bloom in Manu. Mary wants to know what kinds of flowers are blooming in Manu today.

Every day, the weather in Koba is different. Suzie wants to know what the weather is like in Koba today.

Every day, Wug Park holds a different sports game. Daisy wants to know what kind of sport is being played at Wug Park today (Study 2 only)

<table>
<thead>
<tr>
<th><strong>Table 1:</strong> Items used in Study 1 and Study 2 (two additional items were added to keep items even between informant groups)</th>
</tr>
</thead>
</table>

**Forced Choice Trials.** After children indicated whether each informant could answer the question, they were also asked which informant they thought would have the better answer to the question. Children who said they did not know or that both informants would have good answers were prompted to choose between them.

**Omniscience Questions.** To assess whether children believed each informant to be omniscient, children were asked whether they believed that Google could answer every question. They were also asked whether the teacher could answer every question.

**Results**

The R code and de-identified data file for these analyses and Study 2 analyses can be found here: [https://osf.io/pcrkd/?view_only=2b028c7000e54a74b5eee2226e92a6c8](https://osf.io/pcrkd/?view_only=2b028c7000e54a74b5eee2226e92a6c8)
**Familiarity**

Fifty-six percent of children \((n = 67)\) had seen or heard of Google before. Of the children who had seen or heard of Google search before, 55% \((n = 37)\) said they had used Google Search themselves and 83% \((n = 56)\) said they had seen someone else use Google before. A binary logistic regression revealed that children’s familiarity with Google \((B = .71)\), was related to age, such that older children were more likely to say they had seen or heard of Google before than younger children \((ps < .001)\). Children’s use of Google search and observations of others using Google search were not related to age, perhaps because these children were already part of an older subset of children.

Ninety-five percent of children said they had seen a teacher before, with 83% saying they had asked a teacher a question before and 84% saying they had seen someone else ask a teacher a question. Due to children’s overwhelming familiarity with teachers, this variable was not included in the generalized linear mixed model.

**Omniscience**

Of the 110 children asked the post-study omniscience questions, 58 (53%) said that they thought Google knew the answer to every question and 35 (32%) said that they believed that the teacher knew the answer to every question. Two binary logistic regressions revealed that children’s beliefs about a teacher’s omniscience were related to age, but their beliefs about Google’s omniscience were not. Older children were less likely to ascribe omniscience to a teacher than younger children were \((p < .001)\) but just as likely to ascribe omniscience to Google. See Figure 2 for the predicted probabilities that children in the sample would indicate that each of the informants could know the answer to every question.
Figure 2. Predicted Probabilities of Study 1 Omniscience Attributions

Figure 2: The predicted probabilities that children across the sample age range would say that Google or teachers can know the answer to every question.

**Endorse Trials**

To examine the effects of age, informant, and question type on children’s endorsement of the informant’s responses, we developed a generalized linear mixed model (GLMM) using the glmer function with the bobyqa optimizer in the lme4 package (Bates et al., 2015) in R version 4.0 (R Core team, 2020). The fixed effects in the model were informant (human or Google) and question type (stable or changing), and child age (centered at its mean) was included as a continuous predictor. The model also included 2-way and 3-way interactions between informant, question type, and age, and random

---

1 In the initial model that considered order effects, there was a significant two-way interaction between order and informant \((p = .009)\) where children who saw the teacher said the teacher could answer questions more frequently than those who saw the teacher second. However, this effect did not impact children’s overall preference for Google or any of the other observed model relationships, and thus was excluded from the findings.
intercepts for child and item. A logit link function was used because the dependent variable was binary. In order to further examine the effect of our results, we used the function “lme.dscores” using R package EMAtools (Kleiman, 2017) in order to generate Cohen’s d values for the significant main effects and interactions in our Endorse model. These values are listed below where appropriate.

There was a significant main effect of informant, such that children more frequently endorsed Google than the teacher ($\beta = -0.77$, $95\%\ CI = [-1.10, -0.43]$, $p < .001; d = -1.8$) and a significant main effect of Question Type, such that children more frequently said that questions about stable information were answerable than those about changing information ($\beta = 0.37$, $95\%\ CI = [0.04, 0.70]$, $p = 0.029; d = .81$). These main effects were subsumed by a two-way interaction between Age and Informant, such that children’s endorsements of Google increased, and their endorsements of a teacher decreased with age ($\beta = -0.91$, $95\%\ CI = [-1.13, -0.69]$, $p < .001; d = .34$; see Figure 3).

Figure 3. Children’s Endorsements of Google and a Teacher by Age
Additionally, we conducted GLMM analyses with iterations of the same base model described above containing additional fixed effects for familiarity with Google, children’s attribution of omniscience to Google, and children’s attribution of omniscience to a teacher. There was a two-way interaction between familiarity and informant, such that children who were familiar with Google more frequently endorsed it than children who were not \((p = .008)\). Familiarity was not significantly related to age \((p = .33)\).

There were similar two-way interactions between responses to the omniscience questions and children’s endorsements, such that children who said that the teacher was omniscient more frequently endorsed the teacher than those who did not \((p < .001)\), and children who said that Google was omniscient more frequently endorsed Google than those who did not \((p < .001)\). In the Google omniscience model, there was also a three-way interaction between Age, Informant, and omniscience response such that as child age increased, children’s willingness to endorse Google increased more if they also said Google was omniscient than if they had not \((p = .01, \text{see Figure 4})\). In all three of these subsequent exploratory models, the main two-way interaction between age and informant remained significant \((ps < .001)\). Thus, the base model above was used to report main effect and interaction p-values for parsimony, rather than using either of the omniscience models as the main model.
Figure 4. Children’s average endorsement of Google and a person across age, grouped by whether children had said that Google was omniscient, with confidence intervals. Older children who said Google was omniscient more frequently endorsed Google than older children who had not.

**Forced Choice Trials**

We conducted a second GLMM analysis with the dependent variable of children’s forced choice responses of Google or a teacher having the better answer. The model structure was the same as described in the Endorse Trials results.

The analysis revealed a significant main effect of age such that as participant age increased, selection of Google increased ($\beta = -0.90$, 95% CI = [-1.31, -0.49], $p < .001$; $d = -0.92$). There was also a main effect of question type, such that Google was selected more
frequently for answering stable information questions than changing information questions, \(\beta = -0.52, 95\% CI = [-0.83, -0.20], p = 0.001; d = -1.43\).

**Discussion**

Taken together, the findings of Study 1 provide insights into 4- to 6-year-old children’s judgments about the Google search engine. Even very young children place a high degree of trust in Google, and with increasing age, children’s endorsements of Google become more frequent than their endorsements of and preference for a knowledgeable person. Young children not only see Google as a viable informant, but contrary to their trust in a person’s capacities, their trust in Google’s capacities only increases as they enter elementary school.

Despite their high degree of trust in Google, children ages 4-6 do not appear to distinguish between stable and changing information when it comes to endorsing Google or a person more frequently. Although one of the strengths of search engines like Google is that they can access live and updating information, participants chose Google over a person more frequently for stable questions than changing questions, suggesting that they are not yet aware of Google’s relative strength at providing changing information.

Additionally, children who were familiar with Google were more likely to endorse it, suggesting that early exposure to Google search may impact the level of trust that children have in Google and related technological informants. Moreover, in this circumstance, children appeared to privilege the technological informant over the familiar human informant, even though Google was less familiar. Although not all participants had heard of Google, children in this age range may show a preference for Google over
the Internet or a novel search engine because it is more familiar to them than other online sources.

Interestingly, children’s attributions of omniscience to Google did not vary with age, though their beliefs about a person’s omniscience decreased with age. Young children sometimes conflate expertise with omniscience, selecting a domain appropriate informant for an omniscient one (Lane et al., 2014). In other words, children will often choose a doctor for health-related information, even when provided with an entirely omniscient person as an alternative. As children grow older and begin to use search engines independently, it may be that children believe that an Internet-based informant with access to a broad range of knowledge can answer every, or nearly every, question at the same rate as younger children. Given that other studies suggest that children’s skepticism in the Internet increases with age, Study 2 explores whether slightly older children will also say that they believe Google knows everything.

**Study 2**

Although not all the children in Study 1 were familiar with Google, children endorsed Google more frequently than they did a teacher, especially as participant age increased. Google has qualities that may set it apart from other technological informants, such as a familiar name, and a relatively simple interface. In order to explore whether these qualities impact children’s high levels of trust in Google, Study 2 extended the findings in Study 1 by comparing young children’s trust in Google as opposed to a teacher, but also as opposed to two other technological informants. The first was a potentially less familiar and less clearly-defined or accessible technological informant: the Internet. Given that young children have difficulty understanding how the Internet
works, we were interested in whether young children would show a preference for
Google over the network that it uses to get its results (i.e., the Internet). Moreover, in
Study 1, familiarity was significantly linked to children’s judgments about Google.
Therefore, we also included a novel search engine, which we called Anu, after the Irish
goddess of wisdom, as a comparison point in Study 2.

Additionally, in Study 1, children did not change their intuitions about when they
thought Google and a teacher could answer questions based on if the information was
changing or stable. Although they did select Google more often in the forced choice
condition for stable items than changing ones, this intuition is not necessarily correct.
One of the advantages of Google search is that it can provide updates to ongoing or
breaking stories or changing information like the weather. We also therefore extended the
age range of Study 2 to now include 7- and 8-year olds in order to see whether children’s
understanding of Google’s utility for current event questions develops before age 9.

Methods

This study was pre-registered. The pre-registration can be found at:


Participants

Participants included 120 4- to 8-year old children ($M_{age} = 6.53$, range = 4.10-
8.93; 59 girls, 61 boys). Three additional participants were excluded due to inability to
pass the check questions. Participants completed the study online via a Zoom call ($n =
37$), in person at their preschool or after school care program ($n = 31$), at a science
museum ($n = 14$), or in a laboratory in Louisville, KY ($n = 38$). Eighty percent were
identified by their parents as White or Caucasian-American, 4% as Asian-American, 6%
as Black or African-American, and 9% were identified as belonging to two or more races. One additional parent did not identify their child’s race. Most participants (93%) were identified as non-Hispanic, 6% were identified as Hispanic, and ethnicity information was not provided for one child. The sample size used was equivalent with the sample size from Study 1. The parents of the 37 children who participated online were also asked questions related to parental education and income, as indicators of SES. Over half of children in these families (54%) had at least one parent with a graduate degree and over half of children (57%) had families with a household income of $100,000 or greater.

**Materials**

Children viewed images on a computer screen through a powerpoint presentation. Materials can be found here:

https://osf.io/pcrkd/?view_only=2b028c7000e54a74a74b5eee2226e92a6c8.

**Procedure**

**Introduction and Check Questions.** Children completed the same check question procedure outlined in Study 1. The listening check questions were not included in Study 2. Some children were introduced to the teacher first, and others were introduced to the first technological informant first. In subsequent trials, children were introduced to the new technological informants, but not re-introduced to the teacher.

**Google Introduction.** Children were told that they were going to talk about Google Search. The experimenter script for the introduction to Google was the same as in Study 1.

**Anu Introduction.** Children were told that they were also going to talk about a search engine called Anu Search. The experimenter script for the introduction to Anu was
identical to the introduction to Google excepting the name of the search engine. The experimenter then presented an example of a search process with a question about the most popular pizza topping in the United States.

**Internet Introduction.** Children were also told that they were going to talk about the Internet. The Internet was introduced as “a group of connected computers, which can get information from each other to help answer questions. If someone has a question, they can use the Internet to answer the question.” Children were then shown an example of a generic Internet browser that could help answer a question about the most popular sport in the United States.

**Teacher Introduction.** The experimenter script for the introduction to the teacher was the same as in Study 1.

**Familiarity Questions.** To explore children’s familiarity with Google and with a teacher, children were asked if they had ever seen or heard of each of the technological informants. If children said they had heard of Anu before, they were told that they could not have heard of Anu because it was a brand-new search engine. Children were also asked if they had ever seen a teacher before.

**Endorse Trials.** Children were told that the experimenter would be telling them about people who have a question because they want to know something. Children were instructed to indicate who the third-party person could consult to find the correct answer. Children were then presented with a series of twelve questions asked by third-party people. Six were about stable general knowledge information and six were about changing information (see Table 1 for full list of items). Order was rotated to control the order in which technological informants were introduced, and which items they were
paired with. After each target question, children were asked if the technological informant could answer the question and if the teacher could answer the question. Children could answer yes or no for each informant.

**Forced Choice Trials.** After children indicated whether each informant could answer the question, they were also asked which informant they thought would have the better answer to the question. Children who said they did not know or that both informants would have good answers were prompted to choose between them.

**Omniscience Questions.** To assess whether children believed each informant to be omniscient, children were asked whether they believed that Google could answer every question, Anu could answer every question, and the Internet could answer every question. They were also asked whether the teacher could answer every question.

**Results**

**Familiarity Questions**

Nearly all participants ($n = 113$, 94%) had seen or heard of a teacher. Similarly, 84% ($n = 101$) of participants had heard of Google before and 81% ($n = 97$) had heard of the Internet before. Of the 19 participants who said they had not heard of Google before, 10 were 4 years old, 7 were 5 years old, and 2 were 6 years old. Because a high percentage of children were familiar with each informant, familiarity was not considered in the main analyses. A series of logistic regressions showed that familiarity with the teacher, the Internet, and Google was significantly positively related to age ($ps < .001$), suggesting that it was mostly younger children in the sample who were unfamiliar with each of the three informants. Most children also correctly identified that they had not
heard of Anu before, with only 10% \((n = 13)\) saying that they believed that they had heard of Anu before.

**Omniscience Questions**

Fifty one percent of children said that Google was omniscient, 50% said the Internet was omniscient, 38% said that Anu was omniscient, and 23% said that a teacher was omniscient. A series of logistic regressions revealed that all four of these judgments were negatively related to children’s age \((ps < .001)\). The predicted probabilities that children would attribute omniscience to each of the four informants was again calculated (Figure 5). However, these probabilities should not be conflated with children’s mean responses and the relationship between response and informant.

Figure 5. Predicted Probabilities of Omniscience for Study 2

*Figure 5: The predicted probabilities that children across the age range would say that each of the informants could answer every question.*
Given the patterns observed in Figure 5, it is of interest to compare children’s omniscience attributions by informant type directly. Therefore, an exploratory multilevel model was conducted that treated informant (Anu, Internet, Google, Teacher) and age (measured continuously) as fixed effects. Participant was also included as a random effect. This analysis is outside of the scope of the study pre-registration and is therefore purely exploratory in nature. This analysis revealed a significant main effect of informant, driven by less frequent attributions of omniscience to Anu ($\beta = -1.27$, 95% CI $[-2.10, -0.45]$, $p = .002$, $d = -.33$) and the teacher ($\beta = -3.29$, 95% CI $[-4.38, -2.19]$, $p < .001$, $d = -.67$) than to Google or the Internet. Omniscience attributions did not differ between Google and the Internet. However, these main effects were subsumed by a significant two-way interaction between Age and Informant. This interaction was driven by differences between all three of the technological informants and the teacher ($ps < .001$, see Table 3 for other statistical values) and by differences between the developmental patterns of children’s responses about the Internet and their responses about Google ($\beta = -0.80$, 95% CI $[-1.60, -0.01]$, $p = 0.047$, $d = -.21$; see Figure 6).

Younger children more frequently attributed omniscience to Google than older children did, with the youngest children in the sample attributing omniscience at rates nearing 90% and the oldest children in the sample attributing omniscience at rates of around 10%. By contrast, children’s intuitions about the omniscience of the Internet stayed more stable across age, with the youngest children in the sample attributing omniscience approximately 70% of the time and the oldest children in the sample attributing omniscience approximately 30% of the time.

Table 2. Omniscience Model Teacher Interaction Statistics
Table 2: Multilevel Model betas, confidence intervals, p values, and d scores for each comparison of technological informant to teacher in the Informant x Age interaction.

<table>
<thead>
<tr>
<th>Effect</th>
<th>Standard Beta</th>
<th>Confidence Intervals</th>
<th>p value</th>
<th>d score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age by Informant Interactions: Teacher v. Technology Sources</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Google v. Teacher</td>
<td>-1.44</td>
<td>-2.46, -0.41</td>
<td>.006</td>
<td>-.14</td>
</tr>
<tr>
<td>Anu v. Teacher</td>
<td>-1.79</td>
<td>-2.79, -0.78</td>
<td>&lt; .001</td>
<td>-.27</td>
</tr>
<tr>
<td>Internet v. Teacher</td>
<td>-3.29</td>
<td>-4.38, -2.19</td>
<td>&lt; .001</td>
<td>-.36</td>
</tr>
</tbody>
</table>

Figure 6. Children’s Average Omniscience Attributions by Age

Figure 6: Children’s average attributions of omniscience to each of the informants across the age range, with confidence intervals.

**Endorse Trials: Omnibus Model Comparing Technology at Large vs. a Person**

To examine the effects of age, informant (technology vs. teacher), and question type on children’s endorsement of the informant’s responses, we developed a generalized linear mixed model (GLMM) using the glmer function with the bobyqa optimizer in the
lme4 package (Bates et al., 2015) in R version 4.0 (R Core team, 2020). The fixed effects in the model were informant (human or Google) and question type (stable or changing), and child age (centered at its mean) was included as a continuous predictor. The model also included 2-way and 3-way interactions between informant, question type, and age, and random intercepts for child and item. A logit link function was used because the dependent variable was binary. In order to further examine the effect of our results, the function “lme.dscores” using R package EMAtools (Kleiman, 2017) was used to generate Cohen’s d values for the significant main effects and interactions in our Endorse model. These values are listed below where appropriate.

This analysis revealed a significant main effect of informant ($\beta = 0.94$, 95% CI = [0.72, 1.15], $p < .001$; $d = .35$) and a significant main effect of question type ($\beta = 0.85$, 95% CI = [0.54, 1.15], $p < .001$; $d = 3.22$). These main effects were subsumed by significant two-way interactions between age and informant and age and question type. First, as participant age increased, children’s endorsements of Google increased and their endorsements of the teacher decreased, replicating the findings from Study 1 ($\beta = 1.28$, 95% CI = [1.06, 1.50], $p < .001$; $d = .50$; see Figure 7). Second, as participant age increased, children’s endorsements of both informants’ abilities to answer questions about current events decreased ($\beta = 0.58$, 95% CI = [0.37, 0.79], $p < .001$; $d = .21$; see Figure 8).

Figure 7. Children’s Endorsements of Technology and a Person by Age
Figure 7: Children’s endorsements of a person and of the three technological informants (averaged), across age, with confidence intervals.

Figure 8: Children’s Endorsements of Informants by Question Type

Figure 8: Children’s endorsements of informants based on changing and stable question types, across age, with confidence intervals.
**Endorse Trials: Comparing each technological informant to a person.**

To explore children’s intuitions about each of the technological informants (Anu, Google, and the Internet), and how they compared to their intuitions about a person, we ran three subsequent multilevel models using the same procedure described above. In cases where a random effect did not contribute meaningfully to explaining variance or resulted in singularity, it was excluded from the final multilevel model. For the multilevel model with the novel search engine, Anu, the only random effect in the model was Participant. For the multilevel model with Google, the only random effect in the model was Item. Both random effects from the omnibus multilevel model are also in the multilevel model for the Internet. All three models produced a main effect of age, a main effect of informant, and a main effect of time. For the novel search engine, Anu, there were two two-way interactions: an interaction between age and informant and an interaction between age and question type. For Google, there was a single two-way interaction between age and informant. For the Internet, there were two two-way interactions between age and informant and age and question type (see Table 2 for full list of main effects and interactions).

Table 3. Technological Informant Model Statistics

<table>
<thead>
<tr>
<th>Effect</th>
<th>Standard Beta</th>
<th>Confidence Intervals</th>
<th>p value</th>
<th>d score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Google Only Model</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-.61</td>
<td>-.63, -.23</td>
<td>&lt;.001</td>
<td>-.05</td>
</tr>
<tr>
<td>Informant</td>
<td>1.26</td>
<td>.80, 1.71</td>
<td>&lt;.001</td>
<td>.32</td>
</tr>
<tr>
<td>Question Type</td>
<td>.86</td>
<td>.39, 1.34</td>
<td>&lt;.001</td>
<td>3.21</td>
</tr>
<tr>
<td>Age x Informant</td>
<td>.99</td>
<td>.53, 1.44</td>
<td>&lt;.001</td>
<td>.47</td>
</tr>
<tr>
<td><strong>Novel Search Engine Only Model</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-.65</td>
<td>-.90, -.40</td>
<td>&lt;.001</td>
<td>-.07</td>
</tr>
<tr>
<td>Informant</td>
<td>.62</td>
<td>.18, 1.07</td>
<td>.006</td>
<td>.35</td>
</tr>
<tr>
<td>Question Type</td>
<td>.97</td>
<td>.51, 1.43</td>
<td>&lt;.001</td>
<td>.32</td>
</tr>
</tbody>
</table>
Table 3: Multilevel Model betas, confidence intervals, p values, and d scores for each of the technological informants.

In general, these relationships reflect those observed in the omnibus multilevel model. However, it is of note that the pattern with the novel search engine is different than with Google and the Internet. Children do not begin to display a clear preference for Anu over a person until between ages 6 and 7, while the preference for Google and the Internet over a person emerges between ages 5 and 6. Additionally, children under 5 more frequently endorse the person than Anu, but endorsed Google and the Internet at roughly the same rates as they do a person (see Figure 9).

Figure 9. Children’s Endorsements of Technological Informants and a Person by Informant and Age
To explore children’s intuitions about each of the informants in comparison to one another, we ran an additional multilevel model without children’s responses about the teacher so that we could compare across the three technological informants. This multilevel model revealed a main effect of age, such that older children endorsed the technological informants at generally higher rates than younger children did ($\beta = .77$, 95% CI = [.26, 1.27], $p = .003$, $d = -.07$). There was also a significant main effect of technological informant type, where children’s endorsements of Anu were lower than their endorsements of both the Internet ($\beta = .57$, 95% CI = [.03, 1.11], $p = .037$, $d = -.03$) and Google ($\beta = .86$, 95% CI = [.30, 1.41], $p = .003$, $d = -.07$), but their endorsements of the Internet and Google did not differ. There was also a two-way interaction between age and informant ($\beta = -.54$, 95% CI = [-1.08, -.002], $p = .049$, $d = .10$), which was subsumed.
by a three-way interaction between age, block, and question type ($\beta = 1.14$, 95% CI = [.19, 2.10], $p = .019$, $d = .05$). These two- and three-way interactions were driven by differences between Anu and the Internet, such that younger children trusted the Internet at higher rates than Anu for changing information questions, but not for stable questions, while older children trusted both informants to answer both changing and stable questions (see Figure 10).

Figure 10. Children’s Endorsement of Informants by Question Type and Age

Forced Choice Trials

To look at children’s rate of selecting the technological informant over the teacher in the forced-choice trials, we ran another cross-classified multilevel model with Age, Informant Type (Google, Anu, Internet), and Question Type (Stable, Changing) as the fixed effects, and participant and item as random effects. There was a statistically significant main effect of age ($\beta = 0.83$, 95% CI = [0.43, 1.23], $p < .001$; $d = .57$), a
statistically significant main effect of question type ($\beta = 0.90, 95\% CI = [0.39, 1.41], p < .001; d = 1.4$), and a statistically significant main effect of informant type, driven by differences between Google and the Internet ($\beta = -0.36, 95\% CI = [-0.63, -0.09], p = 0.008; d = -.11$), Google and Anu ($\beta = -1.12, 95\% CI = [-1.39, -0.86], p < .001; d = -.35$), and the Internet and Anu ($\beta = 1.12, 95\% CI = [0.51, 1.02], p < .001; d = .24$). These main effects were subsumed by two-way interactions between age and block and between time and block. The interaction of Age and Informant is driven by differences between the Internet and Google ($\beta = 0.39, 95\% CI = [0.12, 0.66], p = 0.005; d = .13$) and between Google and Anu ($\beta = 0.37, 95\% CI = [0.10, 0.63], p = 0.006; d = .17$). As children’s age increased, they chose Google, the Internet, and Anu over a teacher more frequently than younger children did, and all at rates nearing 100% of the time among the oldest children. The youngest children in the sample, by contrast, chose Google over a person in approximately 50% of trials, the Internet over a person in approximately 30% of trials, and Anu over a person in only 22% of trials (see Figure 11).

Figure 11. Children’s Preference for Technological Informants vs. a Person by Age
Additionally, there is a two-way interaction between time and informant driven by differences between Google and the Internet ($p = 0.007$; Std. beta = -0.73, 95% CI [-1.27, -0.20], $d = -.10$) and between Google and Anu ($p = 0.004$; Std. beta = -0.76, 95% CI [-1.28, -0.25], $d = -.10$). Children chose Google and the Internet at roughly the same rate and at a higher rate than they chose Anu for stable questions but they chose Google more than the Internet and the Internet more than Anu for changing questions (see Figure 12).
Figure 12: Children’s Preference for Technological Informants by Question Type.

Discussion

Study 2 replicated the findings of Study 1 by again showing that children’s intuitions about technology and a teacher change with age, with older children trusting technological sources more and a teacher less than younger children do. These patterns vary with the kind of technological source in question. Although even young children’s trust in technological informants is generally high, their trust is lower in an unfamiliar technological informant (i.e., Anu, the novel search engine) than in familiar technological informants like Google and the Internet. Extending this finding, when asked to choose between a teacher and technological informants, older children selected the technological informants at equally high rates, but younger children selected Google more often than they selected the Internet, and the Internet more often than they selected the novel search
engine. Children under age 7 therefore appear to privilege familiarity when evaluating technological informants. In contrast, children 7 and older seem to treat technological informants as equally capable, perhaps indicating an increased underlying understanding of what technology can do and how it functions.

As in Study 1, although children’s intuitions about technological informants are developing and changing between ages 4 and 9, they do not yet seem to have strong intuitions about the impact of the information’s timeliness on the potential capabilities of informants. Children recognize that current event questions are harder to answer as they age, but not necessarily that one informant is better for answering these kinds of questions than another.

Finally, an interesting pattern emerged in children’s attributions of the ability to “know everything” (i.e., omniscience) to each of the four informants. Children most frequently ascribed omniscience to Google and the Internet, further reinforcing both that children think that technology is generally more capable of knowing than a person, and that children are less likely to evaluate novel technological informants as vastly knowledgeable than familiar ones (i.e., previous experience appears to matter here). Beyond this, though, children’s attitudes towards Google and the Internet varied with age, with younger children more frequently saying that Google knew everything than that the Internet did and older children expressing the opposite intuition.

**General Discussion**

Two studies examined 4- to 8-year old children’s intuitions about familiar and novel technological sources, focusing on search engines and the Internet. Taken together, these studies reveal that children’s willingness to attribute high levels of question-
answering capacity to Google search and similar technological sources begins by age 4 and increases with age, and that children ages 4-8 are not using the timeliness of the information sought to make these determinations. However, there appear to be other factors at play. Across both studies, children’s intuitions about the technological source varied with age, with younger children more frequently attributing knowledge to the teacher and less frequently attributing knowledge to the technological source than older children did.

Although not all the children in the sample had heard of Google Search before (particularly in Study 1, where familiarity with Google was expressed by roughly half of the sample), Google’s familiarity nonetheless appears to play a role in children’s willingness to attribute knowledge capacity to it. Children generally prefer familiar informants to unfamiliar ones (Corriveau & Harris, 2009). Although children’s endorsements of Google did not generally differ from their endorsements of the Internet in Study 2, children also reported being familiar with the Internet in roughly equal numbers. Younger children selected Google in the forced choice condition at higher rates than they selected the Internet, perhaps indicating that though Google and the Internet are equally familiar, they may not feel equally accessible to young children. Alternatively, it is possible that although children report having seen or heard of the Internet before, the vast and complicated nature of the Internet means that children still feel more familiar with the way Google works and what capacities it possesses. Additionally, there were differences in young children’s evaluations of Google and the Internet compared to Anu, which was a novel Internet-based search engine that was designed to be entirely
unfamiliar. These findings suggest that children under 7 take familiarity and prior experience into account when making judgments about the capacities of technology.

Unlike younger children, 7- and 8-year-old children endorsed and selected all three technological informants at equal rates. This finding suggests that, similar to prior work with human informants (Corriveau & Harris, 2009), older children no longer prioritize familiarity to guide their decisions about when technology is a beneficial source, instead relying on their understanding of technology and how it functions. By age 7, children are more capable of successfully using search engines independently (Duarte-Torres et al., 2014). Additionally, American elementary schools often begin teaching digital literacy by kindergarten (International Society for Technology in Education and Common Sense Media, 2024), which means that children in this age group may have encountered search engines at school and received scaffolding around their function and use. Moreover, children older than 6 frequently report having used the Internet to answer their questions before (Girouard-Hallam et al., 2023), suggesting that children in this age group have likely engaged in an independent Internet search. Children older than 7 may therefore understand that even if they have not heard of a specific search engine before, it still operates in ways they are familiar with and trust.

Another major finding from this set of studies is that children ages 4-8 do not appear to take the timeliness of the information sought into account when making decisions about what informants to trust. Although children in Study 1 and Study 2 endorsed all of the informants for questions about changing information less often than for questions about stable information with increasing age, they did not differentiate between technological and human informants for answering these kinds of questions.
Children in these studies demonstrated that they understood that some information changes and other information stays the same; however, the timeliness of the information did not appear to be salient or relevant enough to influence their judgments about people and technology. In Study 1, children selected Google more for stable information questions than changing ones. Similarly, in the forced choice condition of Study 2, children’s selections of Google were higher in the stable condition than the changing condition. Taken together, these findings suggest that even when children under age 9 differentiate between informants (e.g., select Google at higher rates than a teacher or other technological source) based on the timeliness of the information, they do not do so in the most optimal way. Children may have more experience using Google to ask stable information questions, such as questions about movies, games, or celebrities, or other general knowledge information that stays the same over time, leading to a preference for Google in the stable condition but not the changing condition. Children in this age group may also not quite know what to do with changing or updating information yet, as they continue to develop their understanding of time (e.g., Tillman et al., 2018). Future research should examine if and when children appreciate that Google search and related technological tools are particularly valuable for updating and changing information.

Across both studies, children’s beliefs about the omniscience of the technological sources differed from their beliefs about the omniscience of the teacher. In Study 1, children’s beliefs about Google’s omniscience were stable across participant age. In Study 2, children’s likelihood of attributing omniscience to the technological sources decreased with age, but as with Study 1, this decrease happened more gradually across the age range than the decrease in the belief that a teacher could be omniscient. That said,
a substantial proportion of older children (roughly one third of the sample) still indicated that the Internet knew the answer to every question. It is important to note that the omniscience question was designed to directly ask children if they believe that each of the sources can know everything. This question is inherently different from previous work on children’s beliefs about omniscience, which explores their behaviors towards omniscient figures in order to ascertain specific types of understanding, such as whether children believe an omniscient being can know a person’s internal states or preferences (Lane et al., 2014). Even though some children as old as 8 said that the Internet can answer every question, future research should examine whether children follow this belief with accordant behaviors, such as indicating that the Internet could tell them about a person’s internal states or preferences.

There are several limitations to these studies. First, the sample demographics limit the generalizability of the study findings. The samples are relatively homogenous, and most participants came from White, middle-class families in the United States. Future research should include more geographically, racially, and socioeconomically diverse samples to see whether these results replicate across other cultures and lived experiences. Although the samples are relatively homogenous, efforts were undertaken to recruit a sample that did not represent convenience sampling, including broadening study participation to other states through online data collection, and partnering with local after school care programs that provide free and reduced cost services to lower income families. Future research should continue to diversify study samples to examine how diverse identities impact children’s beliefs about technology. Second, these two studies only consider children’s behavioral patterns, and not their reasoning about these choices.
For example, it may be that 7- and 8-year old children are not yet taking the timeframe of the information into account when making decisions about whether to trust a technological device over a person, or it may be that these children are not applying a consistent heuristic to their choice (e.g., some children are selecting the teacher for current event questions because a teacher can directly experience phenomena, and some are selecting Google because they believe it can update more frequently or access more information). Asking children to explain the reasoning behind their choices would allow a fuller picture of what drives children’s decision making, and future work on this topic should include open-ended justifications.

Taken together, these two studies reveal insights into children’s trust in technology as a whole and search engines in particular. Children as young as 4 place high levels of trust in Google and the Internet, and these rates increase as children age. However, their trust in search engines is not unmitigated. Children under 7 use the familiarity of the technological informant to formulate their beliefs about its capacities, and they do not view more complex informants like the Internet or unfamiliar informants like a novel search engine in exactly the same way as they view Google. By age 7, however, children begin to use their previous experience and understanding of technology to apply their intuitions about familiar technology to novel technology, endorsing a novel search engine at the same rates as Google and the Internet. The cues that children use to inform their intuitions about technology appear to change as they develop, and young children in particular may require scaffolding when using an unfamiliar technological tool for the first time. Older children, by contrast, may benefit from digital literacy interventions that both encourage their optimism about the potential
benefits of search engines and the Internet, while also teaching them about the obstacles and limitations of these technological sources.
CHAPTER III

CHILDREN’S TRUST IN GOOGLE’S ABILITY TO ANSWER QUESTIONS ABOUT THE PAST, PRESENT, AND FUTURE

One of the great benefits of the Internet is its ability to update us about current events like the weather, the traffic, or whether our favorite baseball team is tied with their opponent at the bottom of the ninth. Adults use Google search to find answers to many types of questions, and, more importantly, so do children. For example, nearly half of British children between 6 and 11 say that they use Google as often as five times per day, and 91% say that they use Google to answer questions about the world around them (Osborne, 2012; Ofcom, 2023). Given the ubiquity of search engine technology, it is important to ascertain whether children trust search engine results when looking for the answers to their questions. Moreover, Google search is not only useful for finding static information about past events, but also for checking live updates about ongoing events and for finding websites that can forecast future events like elections or sporting results. The current study therefore explores whether 7- to 10-year-old children trust Google search for answers to questions about past, current, and future events.

Children prefer informants that are accurate, and this preference extends from people (Harris et al., 2018) to text sources (Chandler-Campbell et al., 2022) to computers (Danovitch & Alzahabi, 2013). When asked directly, most 6- to 10-year-old children believe that the Internet is an accurate source for information (Girouard-Hallam et al., 2023). In research examining children’s trust in the Internet and related devices, 6- to 10-
year-olds also prefer the Internet to human sources (Girouard-Hallam & Danovitch, 2022; Wang et al., 2019). Children use and interact with Internet-based technology like search engines on a regular basis, but that does not mean that they have a clear understanding of what search engines are or how they function. Indeed, although children know that they should not trust inaccurate information provided by the Internet (Wang et al., 2022), they still have difficulty determining when information on a webpage is not accurate (Einav et al., 2020). Moreover, when asked to explain how the Internet works, children tend to describe how devices that use the Internet function rather than explain the Internet itself, suggesting that they have a limited understanding of the Internet (Brodsky et al., 2021).

In particular, children as old as 12 have difficulty understanding how Google acquires information, often depicting Google as reliant on a group of human individuals, rather than as reliant on a complex algorithmic process (Kodama et al., 2015). This combination of belief in the Internet’s accuracy and limited understanding of the Internet itself may decrease children’s epistemic vigilance and inflate their trust in Google search.

Google is a unique technological informant. Unlike the Internet at large, it has a proper name and sometimes even a “voice” that may make it more friendly to young users. These personifying characteristics can contribute to the perception of a technological entity as socially contingent (Breazeal et al., 2016; Yarosh et al., 2018). Research suggests that children consider social contingency when making decisions about interacting with other technological informants including robots (Breazeal et al., 2016; Chernyak & Gary, 2019) and voice assistants (Strathmann et al., 2020; Yarosh et al., 2018). However, Google also differs from other named technological sources like robots and voice assistants in that it does not have a physical form or the ability to engage
in conversation, characteristics that may make children less likely to believe the answers it provides.

Additionally, children’s trust in technological sources may depend on the kind of information a source provides, including the timeframe for the information. By age 5, children engage in episodic future thinking (Russell et al., 2010; see Atance, 2015 for review), meaning that they can conceptualize that certain events have not happened yet, and that their outcomes may be shaped by past or current events, and they construct mental timelines (Tillman et al., 2018). For example, they can differentiate between events that happened last month versus last week, or that will happen next week versus next month. Importantly, although children begin to grasp concepts of time at age 5, their ability to do so improves with development. There is also some evidence that the timeliness of a question influences children’s preferences for seeking informants that can answer it. Six-year-olds (but not younger children) prefer to consult an iPad to a person for some current event information (e.g., the weather; Eisen & Lillard, 2016). Seven- and 8-year-old children also endorse a voice-assistant’s responses at higher rates than a person’s responses for questions about both information that does not change (e.g., the color of a certain vegetable) and current events (Girouard-Hallam & Danovitch, 2022). The current studies therefore examine whether children trust search engines like Google over human informants for information about past events and current events, and for predictions about near-future events. Given evidence that children ages 7-10 prefer the Internet to human informants, we anticipate that children will prefer Google to a person for questions about past, present, and future events, but that their beliefs about
present and future events may also be driven by developmental changes as they age and become more adept at thinking about current and future events.

The current studies compare children’s intuitions about the Google search engine with their intuitions about a human informant. Children have access to a variety of informants when learning information, both human (e.g., teachers, peers, parents) and non-human (e.g., Google search, voice-assistants). Understanding when children seek information from Google as opposed to a person can therefore help inform real-world considerations for teaching children about the advantages of technological or human informants in certain circumstances. Research has suggested that children ages 7-10 prefer the Internet (Wang et al., 2019) and voice-assistants (Girouard-Hallam & Danovitch, 2022) over human informants, but this research has largely dealt with general knowledge facts or information about past events. We anticipate that younger children in this age range may still prefer a human informant over Google search for current events and future predictions because their technological competency and understanding are still improving (Yan, 2005, 2006, 2009) and they may not yet understand that Internet-based sources are particularly useful for current information.

These studies also focus on children ages 7-10 because children in this range are likely to have both heard about and interacted with the Internet independently at home or at school (Dodge et al., 2011), and they may already be using search engines on their own (Dragovic et al., 2016; Duarte-Torres et al., 2014). Additionally, children in this age range can construct a mental timeline of past, present, and future events (Hudson & Mayhew, 2011; Zhang & Hudson, 2011). As children grow older, their burgeoning executive function, decision making, and inhibition may in turn impact their ability to
make decisions about when to selectively trust certain kinds of informants (Hermes et al., 2018). As children age, they are also increasingly able to think about how meaningful and specific an informant’s information is (Koenig et al., 2015), which could drive their judgments about when and how Google is able to obtain helpful information. Asking children to explain why they would seek information from Google or a person allows us to gain a better understanding of developmental changes in their beliefs about technology.

**Study 1**

**Methods**

**Participants**

Participants in Study 1 were 80 children ages 7 to 10 ($M_{age} = 8.96$, range = 7.01 – 10.99; 39 girls, 41 boys). Three additional participants were excluded due to technological problems and another nine children were excluded because they were unable to complete the inclusion task. Of these nine participants, eight were 7-years-old.

To determine sample size, we performed a two-tail, one sample t-test a priori power analysis in G*Power (Faul et al., 2007) as a proxy for determining level-two group sample size for a multilevel model (see Murayama et al., 2022). We used an effect size value of $d = .32$ (based on Girouard-Hallam & Danovitch, 2022a). The group sample size at power = .80 is 79.

Participants were recruited through social media advertisements and http://childrenhelpingscience.org. Approximately 84% of participants were identified by their parents as White, 4% as Black/African-American, 6% as Asian-American, and 6% were identified as belonging to two or more races. Additionally, 7% of children were
identified by a parent as Hispanic, 90% as non-Hispanic, and ethnicity information was not provided for 3% of participants. Seventy-nine of the children who participated lived in the United States and one child participated in India. Excluding this child would not change the pattern of the results. Additionally, 30 families were asked for SES related data, including the highest level of education of caregivers in the household and household income. Nearly half of children in these families (46%) had at least one parent with a graduate degree and over half of children (51%) had families with a household income of $100,000 or greater. Therefore, this sample can be described as largely middle and upper class.

**Materials**

Children viewed images corresponding to descriptions provided by the experimenter. Powerpoint slideshows used for this study can be found at:

https://osf.io/t8hjc/?view_only=d2d8e03e59a5421bb0be3cf9d944ea83

**Procedure**

The study took place over a synchronous Zoom video-call led by an experimenter. The study procedure was approved by the University of Louisville IRB (14.0053).

**Timeline Inclusion Task.** In order to ensure that children understood the difference between past, present, and future events, all participants began the experiment with a time inclusion task (adapted from Hudson & Mayhew, 2011). Participants were asked to order three events in order of occurrence from first to last. These events occurred in the past (e.g., Tom rode his bike yesterday), the present (e.g., Mary is playing with blocks today), and the future (e.g., Grace will listen to music tomorrow). Only children
who correctly ordered all three events based on the terms “yesterday,” “today,” and “tomorrow” were included in the study.

**Information Stability Inclusion Task.** To ensure that children understood that information is sometimes stable and sometimes changes, children indicated whether different types of information could change from one day to the next for four items. Two items involved unstable information (e.g., “It was cloudy in Indiana today. Could the weather be different in Indiana tomorrow?”) and two items involved stable information (e.g., “This giraffe has brown eyes. Could the giraffe’s eye color be different tomorrow?”).

The majority of participants indicated understanding of stable and changing information, with 76 out of 80 participants correctly answering all four questions (i.e., correctly identifying material as stable or changing), and the remaining four participants only missing one item. No children were excluded due to their performance on this measure.

**Introduction to Google.** After meeting the inclusion criterion, children heard the experimenter describe Google as “a search engine, which is something that uses the Internet in order to answer questions about different things. If you have a question, you can ‘Google’ it. You do this by typing a question into a box on the screen. After you’ve typed in your question, you can press a button that says, ‘Google Search.’ Google then searches the Internet and shows a page with websites that might have the answer.” This description was accompanied by images of the Google search screen and a sample search output screen (i.e., list of websites).
**Previous Experience.** Children were then asked if they had ever heard of Google before, if they had used Google before, and, if so, they were also asked to give an example of a question they would use Google for. These responses were later transcribed and coded by two independent coders for seven themes based on the responses observed by the experimenters. The themes included general knowledge facts, information about games and entertainment, procedural information (i.e., how to do something), information about current events, information about other people, information gathered for the purpose of completing homework or school projects, and search prompts with the intent of looking at images. Children’s responses could be coded across more than one category. Responses that were irrelevant or inaudible were not included. Final interrater agreement was 96% (kappa = .88).

**Informant Evaluation Task.** Next, children were instructed to listen to questions posed by fictional people about past, present, and future events, with two items per category. Questions about past events included the word “yesterday,” questions about the present included the word “today,” and questions about the future included the word “tomorrow.” Questions were designed to be answerable when paired with any of the three time labels and were piloted with 30 adults to ensure that adults believed they could be answered by at least one of the sources. Questions were presented in one of two counterbalanced random orders, and the time label associated with each question was also rotated across three orders, for six possible orders. After hearing the target question, children were asked if Google could correctly answer the question (yes or no) and if a friend of the fictional person posing the question could correctly answer the question (yes or no). Children were then asked which of the two informants would have the better
answer and why. If children initially indicated that neither informant could answer the question, they were still asked to choose which one would have the better answer, and why.

**Informant Evaluation Justification Coding.** Justifications were transcribed and coded into six categories: knowledge, access to information, prediction ability, accuracy, ability to directly experience an event, and efficiency (see Table 1 for full coding scheme and examples). Additionally, responses were coded for whether they referenced Google, the person, or both informants in their explanation. Responses that were irrelevant (including “I don’t know”) or inaudible were not included. Two coders analyzed half of participants’ responses with 98% interrater agreement (kappa for all categories = .89). The second half of the data was then coded by one of the two initial coders.

Table 1. Study 1 Justification Codes and Examples with Number of Responses Coded in Each Category

<table>
<thead>
<tr>
<th>Code</th>
<th>Examples from Study 1</th>
<th>Google Choice Ns</th>
<th>Person Choice Ns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>“Google knows about everything.”</td>
<td>91</td>
<td>35</td>
</tr>
<tr>
<td>Information</td>
<td>“Google is hooked up to the Internet so it can see what the traffic is like.”</td>
<td>196</td>
<td>36</td>
</tr>
<tr>
<td>Access</td>
<td>“Maybe Google will gather up enough information to make an almost accurate prediction of how many people will come.”</td>
<td>41</td>
<td>20</td>
</tr>
<tr>
<td>Prediction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct</td>
<td>“Because Beth can go to the beach and count the number of people.”</td>
<td>1</td>
<td>47</td>
</tr>
<tr>
<td>Experience</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>“Google is normally more accurate than a lot of people.”</td>
<td>29</td>
<td>16</td>
</tr>
<tr>
<td>Efficiency</td>
<td>“Google is more efficient than a person looking outside.”</td>
<td>32</td>
<td>2</td>
</tr>
</tbody>
</table>

*Table 1: Children were asked to explain why they picked a certain informant at the end of each forced choice question. These answers were then coded by two independent coders to reflect themes present in their responses.*

**Results**
Preliminary analyses revealed that there were no significant effects of order or gender. Variables of order and gender were therefore excluded from further analyses. The data and R Code for Study 1 can be found at:

https://osf.io/t8hjc/?view_only=d2d8e03e59a5421bb0be3cf9d944ea83.

**Familiarity with Google**

Of the 80 children who participated, 77 said that they had either used Google on their own or seen someone else use Google before. Of these children, 27% (n = 22) could not remember what they had used Google for before or did not provide an interpretable answer. The largest percentage of children (48%, n = 37) said that they had used Google to answer questions about scientific phenomena (e.g., “what a landslide is”, “which ant is the fastest”), celebrities (e.g., “a famous person’s birthday”), video games (e.g., “the location of something in a game I play”), or other general facts (e.g., “the number of rooms in the White House”). In other words, most children who provided an example of a question said that they used Google for established information (i.e., a finite event occurring in the past or stable fact). Another 9% (n = 7) of children said they had used Google to look for how to undertake a process or task (e.g., “how to join a meeting on Zoom”). Notably, 11% (n = 9) of children said that they had used Google to look for information about a current event (e.g., “the hours for Holiday World” that day) and the remaining children (n = 6) all provided a noun (e.g., “evaporated milk”) without other context. Given how Google search works, we believe that these children may have been indicating that they were looking for an image of the noun they provided.

**Informant Evaluations**
To address the impact of age, informant, and question type on children’s judgments, we developed a generalized linear mixed model (GLMM) using the glmer function with the BOBYQA optimizer in the lme4 package (Bates et al., 2015) in R version 4.2.2 (R Core team, 2022). The fixed effects in the model were informant (human or Google) and question type (past, present, future), and child age (centered at its mean) was included as a continuous predictor. The model also included 2-way and 3-way interactions between informant, question type, and age, and random intercepts for child and item. Random intercepts were added one at a time to the base model (Informant x Question Type x Age) until a model that was parsimonious and explained the most variance was reached. A logit link function was used because the dependent variable was binary. Note that we explored including children’s familiarity with search engines in the model but found that this factor did not significantly improve model fit, due to children’s high level of familiarity with Google (92% of participants had either used a search engine themselves or watched someone else use one). The function “lme.dscores” in the EMAtools R package (Kleiman, 2017) was used to generate Cohen’s $d$ values for the significant main effects and interactions.

In the final model, there was a significant main effect of question type where children were more likely to believe that questions about the past could be answered more often than questions about the present ($B = -0.59$, 95% CI [-1.00, -0.18], $p = 0.005$, $d = .21$) and that questions about the past ($B = -1.64$, 95% CI [-2.06, -1.22], $p < .001$, $d = .56$) and the present ($B = -1.05$, 95% CI [-1.45, -0.65], $p < .001$, $d = .54$) could be answered more often than questions about the future, regardless of which informant was answering the question.
Additionally, children’s endorsements differed by informant, $B = 2.34$, 95% CI [1.74, 2.95], $p < .001$, $d = .60$. Children were more likely to say that Google could answer the question than they were to say that the person could answer the question. This main effect was subsumed by a significant two-way interaction between Age and Informant, $B = 0.70$, 95% CI [0.19, 1.22], $p = 0.007$, $d = .18$, which was in turn subsumed by a significant three-way interaction between Age, Informant, and Question Type, $B = -0.75$, 95% CI [-1.49, -.01], $p = 0.049$, $d = .14$. The three-way interaction was driven by differences between judgments regarding questions about past events and present events (see Figure 1). Children’s judgments about each informant’s ability to answer questions about the past were consistent across age, but older children were more likely than younger children to ascribe the capacity for answering questions about current events to Google and less likely to do so than younger children for the human informant.

Figure 1. Children’s Endorsements of Google and a Person across Age and by Question Type
Figure 1: Children’s willingness to endorse Google and a person’s ability to answer questions about past, present, and future events, where 0 indicates endorsing the source in 0% of trials and 1.00 indicates endorsement in 100% of trials. Confidence intervals indicated.

**Forced Choice Trials**

To examine the impact of age and question type on children’s responses in the forced-choice trial (e.g., whether children indicated that Google or a person was better at answering the target questions), we developed a second generalized linear mixed model (GLMM). The fixed effects in the model were question type (past, present, future) and child age (centered at its mean), which was included as a continuous predictor. The model also included 2-way interactions between question type and age, and random intercepts for child and item.
In the final model, there was a significant main effect of age, $B = 0.60$, 95% CI [0.14, 1.06], $p = 0.011$, $d = .32$, where children increasingly chose Google as having the better answer as participant age increased. Children’s rates of selecting Google as the better source also differed with question type, where children were more likely to indicate that Google would be better than a person at answering questions about the future ($M = .86$, $SD = .39$) than for answering questions about the past ($M = .81$, $SD = .38$), $B = 0.73$, 95% CI [0.25, 1.21], $p = 0.003$, $d = .17$. However, children’s forced-choice responses for questions about the present ($M = .83$, $SD = .41$) did not significantly differ from either the past or future conditions. There were no significant interactions observed in the model.

**Justifications**

Of 480 total justifications collected and transcribed, 42 justifications (5%) were coded as irrelevant, no response, or “I don’t know.” Children chose Google as the superior information source in 367 of the remaining 438 trials, or 83% of the time. Children’s responses were allowed to be coded in more than one category, and so percentages may not add up to 100% (see Table 1). The largest proportion of children’s justifications (53%) related to information access. Responses about information access frequently referenced either access to the Internet and Internet-based tools (e.g., websites, YouTube) or other people who put information online (e.g., scientists, weathermen). In items about current events, children also mentioned Google’s ability to update frequently or to access live recordings. A quarter of children’s responses (25%) also considered Google’s mental states and capacity for knowledge. At times, children even ascribed near-omniscience to Google (e.g., “Google knows almost everything”). Additionally, 11% of responses referenced Google’s ability to predict events by drawing from
previously available information (e.g., “Google would have a score table of how both teams have been doing, so they might be able to determine which one might win or lose even as a best guess from that.”). Responses more rarely referenced Google’s accuracy (8%) or its efficiency (9%), and they often did so in conjunction with responses citing information access or knowledge. In contrast to children’s responses when they chose the person (see below), children almost never referenced Google’s ability to directly experience something as a reason for choosing it (< 1%).

In some cases, children who chose Google justified their response by detailing the limitations involved in asking a person. Thirteen percent of children’s responses when they chose Google stated that a person would need to directly experience an event to know the answer to a question about it. Children also referenced a person’s lack of specific knowledge on the topic in the question or access to information that could answer the question in 19% of responses. Finally, children’s justifications for choosing Google sometimes included concerns about the person’s ability to be accurate (4% of trials) or to make reasonable predictions (5%).

Children selected the person as having the better answer much less frequently than they selected Google (71 of 438 codable trials; 17%). Overwhelmingly, when they did so, children justified their choice by citing the person’s potential for direct experience (80%). These justifications referenced that a person could attend or witness an event that would allow them to know the answer. Additionally, children pointed out that Google cannot have experiences of its own (i.e., it is unable to travel to a sports game or go outside and see what the weather is like) in 8% of responses. Some responses (17%) indicated the belief that Google could not access certain kinds of information in certain
circumstances. For example, some children said that Google’s ability to update information could not keep up with events as they occurred (e.g., “If Tia is at the game she could see the score right away, but Google might not have updated yet”).

To compare justifications by age, individual independent chi square goodness of fit tests were conducted between two age groups (7-8-year-olds and 9-10-year-olds). Older children were less likely than younger children to reference intelligence in their responses \( (\chi^2 = 6.43, p = .011) \) and more likely to reference the informant’s ability to access information \( (\chi^2 = 5.25, p = .021) \) and to provide an accurate response \( (\chi^2 = 28.17, p < .001) \). All other comparisons were not significant.

**Study 1 Discussion**

Almost all children in the sample had previously used Google, and most children said they used Google to look up factual information, establishing that Google was a familiar source. In general, children felt that Google was a preferable informant to a person. Specifically, children endorsed Google’s ability to answer questions about the past in approximately 70% of trials, while they endorsed the person’s ability to do so in around 50% of trials. Importantly, children’s intuitions about Google when asked about current events were significantly different than their intuitions about past events and varied with age. In the current event trials, older children endorsed Google at significantly higher rates than a person. They also endorsed Google significantly more often and the person significantly less often than younger children did. Children’s reasoning about Google and a person provides insight into these patterns: when justifying their responses, children frequently cited Google’s ability to amalgamate information from many sources, thereby acquiring a larger knowledge base than a person can have.
Children also believed that Google was better able to answer questions about the future than a person. This difference becomes more pronounced with age, though there were no significant differences between children’s intuitions about future questions as compared to their intuitions about past and present questions.

These results suggest that children can and do take the timeliness of the information sought into account when thinking about which informant to trust. However, there are several limitations to these findings. First, children could have interpreted questions about “today” as being about a near-past event (e.g., if the study was conducted in the afternoon, the event could have occurred in the morning). Second, children’s intuitions about future events were less clearly defined than their intuitions about past and present events. Children were less likely to say that they thought either informant could answer questions that required future predictions, suggesting that children may have difficulty understanding when information can be collected and used to make a prediction about something that has not happened. Additional research is necessary to further explore children’s intuitions about technology’s ability to predict future information.

**Study 2**

To confirm and extend our findings from Study 1, the experimental paradigm was modified to focus on the interaction between children’s intuitions about Google for queries about past versus current events. In Study 1, older children increasingly treated past information differently from present information. Study 2 aimed to replicate this finding when the present information was described somewhat differently. To ensure that children considered the ways in which information can change in real-time, Study 2 involved events described as happening “right now.” This immediacy is truer to “current
event” information like breaking news stories, live sporting matches, elections, and other real-world phenomena. To further highlight the difference between past and present information, current event items in Study 2 were also directly paired with past event items. This methodological change ensured that the kind of event occurring at a given timepoint would not impact children’s responses (e.g., in Study 2, they heard a question about a sporting event that occurred yesterday and a sporting event that occurred “right now”).

In addition to these methodological changes, Study 2 examined whether children’s general attitudes towards the Internet relate to their intuitions about Google’s capacity and their decision to endorse Google over a person. To explore this possibility, we added a measure of children’s Internet attitudes (Girouard-Hallam et al., 2023). This eight-item measure specifically targets children’s underlying beliefs about the Internet’s accuracy and the Internet’s scope, and measures children’s comfort using the Internet. Given that search engines rely on the Internet in order to be effective, children’s beliefs about the Internet may play a role in their determination about whether to use an Internet-based information source.

Study 2 Methods

Pre-Registration

This project was pre-registered via As Predicted. The link to the pre-registration is: https://aspredicted.org/blind.php?x=WV7_GDB

Participants

Participants in Study 2 were 84 children ages 7 to 10 ($M_{age} = 9.00$, range = 7.01-10.98; 41 girls, 43 boys). Two additional participants were excluded because they were
unable to complete the time inclusion task, and one additional participant was excluded due to experimenter error. No child had participated in Study 1.

Participants were recruited through social media advertisements and http://childrenhelpingscience.org. Approximately 67% of participants were identified by their parents as White, 7% as Asian-American, 6% as Black/African-American, and 10% were identified as belonging to two or more races. Additionally, 6% of children were identified as Hispanic, and race and ethnicity information were not provided for 4% of participants. The parents of the 40 children who participated online were also asked questions related to parental education and income, as indicator of SES. Over half of children in these families (65%) had at least one parent with a graduate degree and over half of children (63%) had families with a household income of $100,000 or greater. Therefore, this sample can be described as largely middle and upper class.

Materials

Children viewed images corresponding to descriptions provided by the experimenter. Powerpoint slideshows used for this study can be found at: https://osf.io/t8hjc/?view_only=d2d8e03e59a5421bb0be3cf9d944ea83

Procedure

The study took place over a synchronous Zoom video-call or in person at a university laboratory. This study was approved by University of Louisville IRB (14.0053).

Time Inclusion Task. The time inclusion task from Study 1 was retained in Study 2 to ensure that children could construct a mental timeline of near past, present, and near future events.
**Introduction to Google.** The introduction to and questions about Google were the same as in Study 1, and responses were coded according to the method described in Study 1. Two independent coders coded responses with 97% interrater agreement (kappa = .89)

**Informant Evaluation Task.** Children were instructed to listen to questions posed by fictional people that were divided into two categories with five items each: past events and current events. Questions about past events included the word “yesterday” and questions about current events were described as occurring “right now.” Questions were presented in pairs, such that there was a question about the same type of event in the past and present. For example, children were told about a person who wanted to know the “score of the soccer game right now” and a person who wanted to know “what the final score of yesterday’s soccer game was.” Questions were presented in one of two counterbalanced random orders. After hearing the target question, children were asked the same set of follow-up questions described in Study 1.

**Internet Attitudes and Beliefs.** Children completed the Children’s Internet Attitudes Scale (CIAS; Girouard-Hallam et al., 2023). This two-part scale includes six yes/no items about children’s experiences with the Internet and 8 items about children’s attitudes towards and beliefs about the Internet. These eight items use a four-point YES-yes-no-NO scale, and responses were then converted to a score of 0 to 3. These scores were then totaled across the three categories defined by the scale: Comfort, Accuracy, and Scope. Six initial participants did not complete the CIAS as it was added to the study after they participated. Exploratory analyses involving the CIAS therefore included only the 78 participants who completed the CIAS post-measure.
**Justification Coding.** Justifications were transcribed and coded into 6 categories (excluding responses that were inaudible, unintelligible, or “I don’t know”). These categories matched those used in Study 1 (see Table 2) with one notable exception: instead of “predictive capability,” a general category for “references to time” was created. Children were no longer asked about future events, but the time in which an event occurred may still impact children’s decision making. Therefore, this category captured responses where children’s beliefs about the ability of the informant they had chosen were predicated on the timeframe in which the information occurred (e.g., “Google can tell you about things that happened yesterday” or “Google knows what is happening right now.”) Additionally, responses were again coded for whether they referenced Google, the person, or both informants in their explanation. Two coders analyzed half of participants’ responses with 93% interrater agreement (kappa for all categories = .82). Disagreements were resolved via discussion. The second half of the data was then coded by one of the two initial coders.

Table 2. Justification Coding and Examples for Study 2 with Number of Responses

Coded into Each Category

<table>
<thead>
<tr>
<th>Code</th>
<th>Examples from Study 2</th>
<th>Google Choice Ns</th>
<th>Person Choice Ns</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>About Google</td>
<td>About Person</td>
</tr>
<tr>
<td>Knowledge</td>
<td>“Google is really smart.”</td>
<td>174</td>
<td>12</td>
</tr>
<tr>
<td>Information</td>
<td>“Because Google is connected to multiple things and has multiple weather stations on there on their website.”</td>
<td>227</td>
<td>9</td>
</tr>
<tr>
<td>Access</td>
<td>“Google is all about recording new answers the moment they happen, and it more than likely has the answer for right now”</td>
<td>65</td>
<td>0</td>
</tr>
<tr>
<td>Time</td>
<td>“Her friend probably played on the soccer team.”</td>
<td>0</td>
<td>74</td>
</tr>
<tr>
<td>Direct Experience</td>
<td>“Google would probably be more exact”</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>Accuracy</td>
<td>“Google could search it up faster and it would have got a correct score.”</td>
<td>28</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 2: Children answered why they picked the informant of their choice in the forced choice condition. Their answers were coded by two independent coders according to the themes present in their responses.

**Study 2 Results**

The data and R Code for Study 2 can be found at:

[https://osf.io/t8hjc/?view_only=d2d8e03e59a5421bb0be3cf9d944ea83](https://osf.io/t8hjc/?view_only=d2d8e03e59a5421bb0be3cf9d944ea83)

**Familiarity with Google**

Almost all children (96%; n = 81) had previously heard of Google Search, and 76% (n = 61) had used Google on their own. Of the 61 responses from children who had previously used Google search, 60% (n = 36) were related to general knowledge facts. Some of children’s responses (16%; n = 10) again mentioned using Google for educational purposes (e.g., “I looked up something for class”). Smaller numbers of responses referenced using Google to look up how to do something (n = 6; 10%), for entertainment purposes (n = 7; 11%), or for information that changes or updates based on when the question is asked, such as current events, current popularity rankings, or breaking news (n = 9; 15%).

**Informant Evaluations**

To address the impact of age, informant, and question type on children’s judgments, a generalized linear mixed model (GLMM) was developed using the glmer function with the BOBYQA optimizer in the lme4 package (Bates et al., 2015) in R version 4.2.2 (R Core team, 2022). The fixed effects in the model were informant (human or Google) and question type (past, present), and child age (centered at its mean) was included as a continuous predictor. The model also included 2-way and 3-way
interactions between informant, question type, and age, and random intercepts for child and item. Random intercepts were added one at a time to the base model (Informant x Question Type x Age) until a model that was parsimonious and explained the most variance was reached. A logit link function was used because the dependent variable was binary. Note that we did not include familiarity in this model because a high proportion of children had either seen someone else use Google or used Google themselves. The function “lme.dscores” in the EMAtools R package (Kleiman, 2017) was used to generate Cohen’s d values for the significant main effects and interactions. Testing location was also considered as a fixed effect in this model, but did not result in any significant main effects or two- or three-way interactions, and thus was not used in the main analysis.

This analysis revealed a main effect of informant ($\beta = 1.36$, 95% CI = [0.75, 1.98], $p < .001$; $d = 2.02$), where children endorsed Google search more frequently than the person. In particular, the oldest children in the sample endorsed Google at very high rates (~80% of trials). This main effect was subsumed by a three-way interaction between age (7-10), informant (Google vs. a person), and question type (past event vs. current event; $\beta = 0.46$, 95% CI = [0.02, 0.82], $p = 0.040$, $d = .12$). Although participants’ endorsements of Google were more frequent than endorsements of the person across the age range, children’s intuitions about Google differed with age based on the kind of question Google needed to answer. For past events, children’s intuitions about Google stayed relatively stable across age. For current events, older children endorsed Google more frequently than younger children did. Additionally, older children endorsed the person more often than younger children for questions about past events, but older
children did so less than younger children for questions about current events (see Figure 2).

Figure 2. Children’s Endorsement of Google and a Person across Age by Question Type

![Graph showing children's evaluations of Google's and a person's capacity to answer questions about past and present events.](image)

**Figure 2.** Children’s evaluations of Google’s and a person’s capacity to answer questions about past and present events, where 0 indicates endorsing the source in 0% of trials and 1.00 indicates endorsement in 100% of trials. Confidence intervals indicated.

**Forced Choice Trials**

To explore the impact of age and question type on children’s responses in the forced-choice trial (e.g., whether children indicated that Google or a person was better at answering the target questions), a second generalized linear mixed model (GLMM) was developed in the same way as the Evaluation trials. The fixed effects in the model were question type (past, present) and child age (centered at its mean), which was included as a continuous predictor. The model also included 2-way interactions between question type
and age, and random intercepts for child and item. Testing location (online vs. in-person) was also considered as a main fixed effect in the model. There was a significant main effect of participating online, such that children who participated online ($M = .26$) more frequently selected Google than participants who participated in person ($M = .35, \beta = -0.65, 95\% CI = [-1.25, -0.06], p = 0.033; d = .43$). However, there were no interactions of testing location with age or time. There was also a significant two-way interaction between age and time, such that children chose Google as having the better answer to past event questions in around 80% of trials, regardless of age, but older children ($M = .20$) more frequently chose Google as having the better answer for current events than younger children did ($M = .41, \beta = -0.27, 95\% CI = [-0.5, -0.03], p = 0.025; d = .12$; see Figure 3). Of note, Google was chosen as having the better answer in 70% of trials overall.

Figure 3. The proportion of children choosing Google across Age by Question Type.
Figure 3: Average proportion of children's choice of Google vs. a Person, where 0 indicates choosing Google in 100% of trials and 1.0 indicates choosing a person in 100% of trials. Confidence intervals indicated.

**Relationship with Internet Attitudes**

To explore whether children’s attitudes towards the Internet impacted their intuitions about which informant would have the better answer, a multiple logistic regression analysis was conducted where the binary dependent variable was children’s forced choice decision. Predictors were added in a stepwise manner according to their point biserial correlation with the dependent variable. There was no relation between children’s comfort using the Internet or their previous experiences online and their forced choice response. Children’s judgments about Internet scope were determined to be significantly related to children’s forced-choice decisions (β = -.19, p < .001), with children who more readily believed that the Internet is a source for information about the past and about science being more likely to indicate that Google would be the better informant to answer the question. Children’s judgments about Internet accuracy were also significantly related to children’s forced-choice decisions (β = -.11, p = .045), with children who more readily believed that the Internet is an accurate source of information more frequently choosing Google as having the better answer.

**Justifications**

Out of 840 total open response trials, only 20 were not codable. Children either responded with “I don’t know” or an unrelated statement or the recordings were unintelligible or inaudible. Just as in Study 1, children chose Google in the majority of trials (569 out of 820 trials, 69%). When justifying this choice, children once again most
frequently referenced Google’s ability to access information (or a person’s inability to do so); they mentioned Google’s access to the Internet or other sources like people and satellites in 42% of their justifications. Many children also justified their choice of Google by talking about their perceptions of Google’s intelligence (e.g., mentioning that Google is smart or stating that it has a high IQ) or the person’s lack of knowledge (33% of responses). As in Study 1, some children's responses (13%) mentioned that people’s experiences are limited and may not allow them to answer every question asked about something, even if they directly experienced the event. Additionally, 11% of children’s responses stated that they chose Google for a reason related to timeliness, such as its capacity to consider live broadcasts or quickly update information. A smaller number of responses stated that Google was more accurate than a person (5%) or that Google was the faster, better, or more efficient source (5%).

Children chose a person as having the better answer in the remaining 251 trials (31%). As in Study 1, the majority of participants’ responses when they chose the person referenced the person’s ability to directly experience an event or interact with an environment (e.g., playing on a sports team or counting people at the beach; 69%). Fourteen percent of responses also stated that there were limitations to Google’s ability to update (i.e., Google might not be able to update fast enough to tell the person with a question about what was happening in the moment). Additional responses referenced limitations to Google’s knowledge or information access (15%) or a person’s accuracy or efficiency (7%).

In order to compare children’s responses by age, we performed chi-square analyses with two age groups (7- and 8-year-olds and 9- and 10-year-olds). Older
children were more likely to reference the informant’s ability to access information ($\chi^2 = 6.21, p = .013$) and to consider the informant’s accuracy ($\chi^2 = 6.95, p = .008$). Older children were also more likely to consider whether the information was about a current event than younger children ($\chi^2 = 4.42, p = .04$). All other comparisons were not significant.

**General Discussion**

Across two studies, we examined children’s trust in Google search compared to their trust in a person for answering questions about past, current, and future events. Taken together, these studies reveal that 7- to 10-year-old children’s trust in Google search is generally high, particularly when asked whether Google will know the answer to questions about events that have already occurred. However, children’s intuitions about trusting Google search also vary with age, with older children placing higher trust in Google (and lower trust in a person) for questions about current events. Children also believe that questions requiring near future predictions are harder to answer for both Google and people, and though their trust in Google is still generally higher, their intuitions about these questions are less clear than for questions about the past or present.

Children’s overwhelming trust in Google may be due in part to its ubiquity. Selective trust research shows that familiarity plays a key role in children’s trust in human informants (Corriveau & Harris, 2009). Because nearly all the children in our studies were familiar with Google, and many reported having used it, they may trust it to the same extent – if not more – than a human source. In addition, because the human source in the current studies was unfamiliar to the child, children’s preference for familiar over unfamiliar sources may have increased their likelihood of selecting Google
over the person. Moreover, although Google and the Internet at large are not the same thing, children’s beliefs about Google are not totally independent of their beliefs about the Internet. Children in Study 2 were more likely to say that Google was the better source of information when they believed that the Internet was accurate and could tell them about different kinds of information. In their justifications, some children also explicitly mentioned Google’s connection to the Internet as a source of information. Thus, although children are unlikely to fully understand the nature of the Internet (Brodsky et al., 2021; Yan, 2005, 2006, 2009), children’s trust in Google is related to their beliefs about the Internet at large.

In addition, the current findings suggest that, between ages 7 and 10, children develop their understanding of Google as particularly useful tool for acquiring information about current events. This developmental change may in part be due to their increasing experience with Google search. Most children in the current studies gave examples of having used Google for general knowledge information or information about past events, and older children in Study 2 were more likely to consider the timeframe of the question in their forced choice justifications. It may be that older children have had more experience using Google for current or rapidly updating information. Future work should examine children’s prior experience with Google in more detail and explore whether these developmental trends hold true for other popular Internet-based technologies, such as voice-assistants or chatbots.

Google’s unique set of characteristics raises another question: do children treat search engines as more like artifacts or more like people? According to the New Ontological Category (NOC) hypothesis (Kahn et al., 2011; Kahn et al., 2012; Kahn et
al., 2013; Severson et al., 2010), children may consider semi-socially-contingent devices to occupy their own category somewhere between pure artifact and human informant (see Girouard-Hallam et al., 2021). Children chose Google as having the better answer to questions in the majority of trials in both studies, and when they provided justifications as to why, their responses usually considered Google’s access to information through its Internet connection or to people who put information online. However, younger children also frequently said that they felt Google was smarter than a person or that it knew (almost) everything. These kinds of statements suggest that children in this age range ascribe more mental states to Google than they would to an artifact. However, children also recognize that Google is limited in its abilities because it is not a person. When children selected the person as having the better answer to a question about a current event, they overwhelmingly did so because only a person could experience something for themselves, such as attending a sporting event or going to the beach. Taken together, children’s justifications reveal support for the NOC hypothesis by indicating that children consider both artifact and human-like properties of Google when deciding whether to trust it.

Although our findings suggest some consistent behavioral and developmental patterns, there are limitations to our data. First, the samples are made up of mostly White, middle-class children from the United States. Future research should include more geographically, racially, and socioeconomically diverse samples to see whether these patterns remain true in populations with different demographic characteristics. Additionally, the majority of children in both samples had previous experience with the Internet. Future work should seek to recruit participants with a range of experiences
online to see whether their experiences shape their intuitions about when to trust Google search.

Taken together, these two studies reveal important insights into children’s trust in Google search. Children use Google to answer questions about the world around them and their trust in its ability to find correct answers to these questions is high. However, their understanding of when Google is most useful, such as for live updating information and breaking news, or for using past data to inform future predictions, improves with age. Therefore, researchers should consider children’s selective trust in technology when the kinds of information sought are not general knowledge or past event facts, and parents and educators should model when a Google search might be most effective for finding answers to questions.
CHAPTER IV
CONCLUSIONS

The purpose of this dissertation was to examine children’s developing intuitions about search engines. The studies reported in Chapters 2 and 3 explored the circumstances under which children are inclined to trust the Google Search engine, as well as several comparison informants: humans (teachers and friends), a novel search engine (Anu), and the Internet. Taken together, these studies demonstrate several developmental patterns. One major finding is that children’s trust in the Google search engine is generally high. By age 4, children say that Google search can answer questions about both stable and changing information in the world around them. This high level of trust in technology may be due to several underlying influences. First, children live in an increasingly technological world, and it is likely that their experiences with technology begin before they can read or write. Second, Google itself may be familiar to children due to its ubiquity (e.g., “to Google” means “to look something up online”; “Google” is not only a search engine, but also a smart speaker), leading children to prefer it over even knowledgeable adults like teachers.

Another major finding is that children’s trust in Google search and even novel search engines and the Internet increases as children get older. This developmental trajectory differs from what happens to children’s trust in human informants, which decreases as children age. Increasing distrust in humans has been attributed to an increase in skepticism and doubt (Mills, 2013) and a general reticence to say “yes” as children age.
So why does this same phenomenon not occur with technological informants? One reason is that the kinds of experiences that children gather with each informant type may be different. Children ask many of their earliest questions to human informants, initially believing that accurate (e.g., Li & Yow, 2018), reliable (e.g., Pasquini et al., 2007), familiar (e.g., Corriveau & Harris, 2009), confident (e.g., Brosseau-Liard & Poulin-Dubois, 2014), and benevolent (e.g., Landrum et al., 2013) adults can provide correct answers to questions. As they age, they begin to recognize that other factors come into play: it’s important for a human informant to have experience with the topic in question, whether that be through expertise (Clegg et al., 2019) or direct experience (Nurmsoo & Robinson, 2009). Additional changes in attentional capacity (Hagen & Hale, 1973) and theory of mind (e.g., Brock et al., 2018) starting around age 6 may allow children to think critically about adult’s information gathering capacity and recognize when they may have not had the requisite experience to answer certain kinds of questions.

In contrast, children’s ability to interact with technological informants increases starting around age 6: they are able to begin to form their own search queries and consult webpages as they learn to read and write (Duarte-Torres et al., 2014) and they may begin using the Internet and related devices to look for school related information or to answer their questions (Johnson, 2010). This increase in their own aptitude with technology may lead to an increased preference for consulting technological sources, particularly as they begin to understand the vast amount of information you can access online. In Chapter 2, some of the oldest children in the samples (6- to 8-year-old children) stated that they believed Google and/or the Internet could answer every question. In Chapter 3, one of the
justifications that children frequently provided for choosing to do a Google search was that Google had access to a broader range of information than a person would, or even that it “knew almost everything.” Some children’s continued attribution of omniscience towards search engines may also increase their resultant trust in Google Search and similar devices. Although children do eventually become skeptical of the Internet and its ability to provide accurate or unbiased information, this skepticism increases significantly between ages 6 and 10 (Girouard-Hallam et al., 2023), and it may become even more sophisticated and nuanced as children develop a better understanding of how the Internet works (Brodsky et al., 2021; Yan, 2005, 2006, 2009) and how search engines work (Kodama et al., 2017). Thus, children ages 6 to 10 may not only have high levels of trust in search engines, but they lack a more nuanced understanding of how search engines work that might mitigate their high level of trust similarly to their decreasing trust in people.

In addition, the cues that children use to determine when to trust search engines also change with age. The results presented in Chapter 2 suggest that children under age 6 use familiarity to guide their judgments about when to trust a technological source, but children age 7 and older do not discriminate between familiar technological informants and unfamiliar ones, instead placing high levels of trust in technological informants in general, perhaps due to their increased experience with and understanding of technology. Strikingly, children do not begin to consider factors beyond the kind of informant until around age 8 or 9, when children begin to use cues like the timeliness of the information sought in the question to guide their judgments about when it might be best to use technology. Children ages 4- to 8 may be aware that questions are different from one
another, but they do not yet have strong intuitions about how that might impact the way in which they treat informants. It may be that some children form one heuristic, such as that people are better at answering current event information because they can directly observe phenomena, a common justification provided by children who selected the person (largely younger children) in the studies in Chapter 3. At the same time, other children may begin to prefer Google for current event questions because of its vast access to information and their perception of its “knowledge,” another common justification observed in Chapter 3. By around age 9, however, children consistently cite Google as a superior source for current event information, largely relying on Google’s access to information, including live or updating information, to formulate those decisions.

Taken together, the findings reported in Chapters 2 and 3 suggest that children use a variety of cues to form judgments about search engines, and that their pattern for trusting these informants differs from their trust in humans. These findings advance current theories of children’s selective trust by exploring children’s trust in little-examined non-human informants, as well as by considering the traits of the informants and the kind of information contained in the questions asked. These studies suggest that, in contrast to human informants, children’s trust in technological informants increases through preschool and early elementary school age. The studies also highlight the importance of qualities like familiarity to children under 6, and the ability to access different kinds of information for children over 8 years of age. Although these studies provide novel contributions to the literature, they are also not without limitations.

First, all four of the studies were conducted between 2020 and 2024. Over 93% of children in the United States completed some portion of their 2020-2021 school year
online, meaning that many of the children in our sample relied on the Internet and search engines in order to access their teachers, other information and resources related to their homework, and even to stay socially connected. This could have led to an overall high level of trust in the Internet and related devices—a “COVID” bubble in technology’s appeal to children that will be mitigated in future cohorts by access to a broader variety of human and text-based resources in an in-person learning environment. Research that engages future cohorts in similar questions about search engines would therefore be warranted, as would longitudinal work that could directly examine how children’s trust in these kinds of sources changes with time and circumstances.

Second, the children in these studies were largely white and middle class, making it difficult to examine sociocultural differences in children’s beliefs about search engines. Work that intentionally examines differences between children of varying racial and ethnic backgrounds or SES would add an additional layer of context to the findings reported in this dissertation. Although children in the United States largely have access to the Internet at home (National Center for Education Statistics, 2023) this access can look different based on their family’s SES, such as a reliance on smart phones as opposed to laptops and tablets in lower SES households (National Center for Education Statistics, 2023) or slower Internet speeds (Vogels, 2021). Research suggests that children are often the ones expected to conduct Internet searches in families (e.g., Correa et al., 2013). Children’s search behaviors may therefore be impacted by the kind of device with access to search engines (e.g., a small web browser on a phone) and the quality of Internet access that they have in their home. By exploring differences in SES, future research can
provide further insights into how these factors influence children’s trust in and use of search engines.

Third, and related to the above point, children also participated in the United States, a Western, educated, industrialized, rich, and democratic (WEIRD) nation (Henrich et al., 2010). Work that considers multiple cultures, including comparisons between WEIRD and non-WEIRD cultures would provide a more comprehensive understanding of children’s beliefs about and trust in search engines. Children in non-WEIRD cultures may be exposed to technology in different ways, or be exposed to different kinds of technology, and examining their trust in search engines would provide increased insight into how children globally treat the Internet and related tools.

Despite these limitations, this dissertation nonetheless provides insight into American children’s trust in search engines, and by extension, their selective trust behaviors as a whole. The findings are relevant not only to developmental psychology research, but to the parents and educators helping children navigate their early experiences with search engines. Younger children are likely to privilege more familiar informants over unfamiliar ones, and still express high degrees of trust in human informants like teachers and other adults. Parents and educators may therefore want to scaffold young children’s early interactions with Internet based tools like search engines by introducing children to their basic functions and limitations and by co-using search engines together. Older children have even higher levels of trust in technological informants than younger children, and it may therefore be worthwhile to provide children with examples of the kinds of information that the Internet and search engines are particularly useful for (e.g., current event information) and the kinds of questions that it
cannot answer in order to buffer children’s enthusiasm about the Internet and related tools and their capabilities. Furthermore, the findings described here can guide further research into children’s Internet search behaviors and beliefs by providing a framework for understanding children’s developing intuitions about search engines.
REFERENCES


https://doi.org/10.3758/BF03193146


https://doi.org/10.1016/j.jecp.2011.06.008

https://doi.org/10.1037/dev0001318


https://doi.org/10.1016/j.cogdev.2023.101338


Lovato, S.B., & Piper, A.M. (2015, June). “Siri, is this you?”: Understanding young children’s interactions with voice input systems. In *Proceedings of the 14th*
International Conference on Interaction Design and Children (pp. 335-338).
ACM.

https://doi.org/10.1145/3311927.3323150


https://doi.org/10.1016/j.ijcci.2018.11.003

https://doi.org/10.1037/a0029500

https://doi.apa.org/doi/10.1037/met0000330

Nurmsoo, E., & Robinson, E. J. (2009). Children’s trust in previously inaccurate informants who were well or poorly informed: When past errors can be excused. *Child Development, 80,* 23-27. [https://doi.org/10.1111/j.1467-8624.2008.01243.x](https://doi.org/10.1111/j.1467-8624.2008.01243.x)


99

https://doi.org/10.1016/j.neunet.2010.08.014


https://doi.org/10.1080/15248372.2020.1867553


https://doi.org/10.1016/j.cogdev.2018.08.006

Strathmann, C., Szczuka, J., & Krämer, N. (2020). She talks to me as if she were alive: Assessing the social reactions and perceptions of children toward voice assistants and their appraisal of the appropriateness of these reactions. *Proceedings of the 20th ACM International Conference on Intelligent Virtual Agents*, 1–8.

https://doi.org/10.1145/3383652.3423906


Turner, E., & Rainie, L. (2020). Most Americans rely on their own research to make big decisions, and that often means online searches. *Pew Research Center*. Retrieved February 28, 2024, from [https://www.pewresearch.org/short-reads/2020/03/05/most-americans-rely-on-their-own-research-to-make-big-decisions-and-that-often-means-online-searches/](https://www.pewresearch.org/short-reads/2020/03/05/most-americans-rely-on-their-own-research-to-make-big-decisions-and-that-often-means-online-searches/)


[https://doi.org/10.1016/j.cogdev.2019.05.006](https://doi.org/10.1016/j.cogdev.2019.05.006)


CURRICULUM VITAE

Lauren Nicole Girouard-Hallam  
she/her  
Legal name: Lauren Nicole Girouard  
Email: lauren.girouard@louisville.edu  
Website: https://laurengirouard13.wixsite.com/lauren-girouard-hall  
Phone: (480) 544 7721

Education

| Beginning SUM 2024 | NICHD T32 Postdoctoral Research Scholar  
University of Michigan  
Ann Arbor, MI  
Start Date: June 1\textsuperscript{st}, 2024 |
| Expected SPR 2024 | PhD in Experimental Psychology  
University of Louisville  
Louisville, KY  
Defense Date: March 27\textsuperscript{th}, 2024 |
| December 2021 | Master of Science in Experimental Psychology  
With Honors  
University of Louisville  
Louisville, KY |
| May 2019 | Master of Arts in Clinical Drama Therapy (Applied)  
New York University  
New York City, NY |
| May 2017 | Bachelor of Science in Neuroscience & Bachelor of Arts in Theatre  
Magna Cum Laude (GPA 3.7)  
Furman University  
Greenville, SC |

Publications


\url{https://doi.org/10.1016/j.cogdev.2023.101338}


*indicates undergraduate student mentee

Manuscripts Under Review and In Preparation


Girouard-Hallam, L.N. & Danovitch, J.H. (under review). Children’s trust in Google’s ability to answer questions about the past, present, and future.

Girouard-Hallam, L.N. & Danovitch, J.H. (under review). Can we Google that?: Children’s beliefs about the informational capacities of search engines, smart speakers, and the Internet


Awards and Honors

2024 Guy Stevenson Award for Excellence in Graduate Studies, University of Louisville

2024 Stories of Science Attendance Partial Fellowship, Stories of Science- Science Communication Bootcamp

2024 Mentored Undergraduate Research and Creative Activities Grant, University of Louisville

2023 Dissertation Completion Award, University of Louisville

2023 SECC Dissertation Award, Society for Research in Child Development

2023 Excellence in Teaching Award, University of Louisville Psychological and Brain Sciences

2023 Student Research Grant, Association for Psychological Science

2023 Commendation Award, Society for the Improvement of Psychology

2022 Student Travel Award, Society for the Teaching of Psychology Annual Conference on Teaching Graduate

2022 Diversity & Inclusion Conference Award, Cognitive Science Society Meeting

2022 Service Award, University of Louisville Psychological and Brain Sciences

2021 Scholarship for Developmental, Child, and Family Psychology, Inter-university Consortium for Political and Social Research (ICPSR) Summer Program in Quantitative Methods of Social Research

2021 Selected participant with honorarium, Communicating Science Conference

2021 Dean’s Citation for Excellence in Masters Degree Studies, University of Louisville

2021 Junior Research Excellence Award, University of Louisville Psychological and
Brain Sciences

2020  *Mentored Undergraduate Student Research Grant Award*, University of Louisville

*Graduate Student Council Research Award*, University of Louisville (awarded 3 times)

*Graduate Student Council Travel Award*, University of Louisville (awarded 5 times)

*Graduate Network of Arts and Sciences Research Award*, University of Louisville (awarded 2 times)

2020-2023 University of Louisville University Fellowship

**Research Presentations**

**Girouard-Hallam, L.N., & Danovitch, J.H.** (2024, March). “*What’s the score right now?*”: *Children’s evaluations of Google’s ability to answer current event questions*. Poster to be presented at the Biannual Conference for the Cognitive Development Society.

**Girouard-Hallam, L.N. & Danovitch, J.H.** (2023, October). *What does Google know?*: *Young children’s beliefs about the capacities of google search*. Poster presented at Purdue University Emerging Perspectives on Early STEM Learning, Development, and Education Workshop


**Teaching Experience**

**Teaching Assistant Courses**
Graduate Student Statistics 1 & 2 (Three semesters, University of Louisville)
Advanced Multivariate Statistics (Summer 2023, ICPSR, University of Michigan)

**Teaching and Mentorship Related Presentations**


Training
Celebration of Teaching and Learning Conference, University of Louisville (2024)
Teaching Circle: Student Belonging, University of Louisville (2024)
Passion Driven Statistics, Online Workshop (2024)
Teaching Statistics with R in Psychology, Nottingham Trent University, Online Symposia (2022)
EdX STEM Inclusive Teaching Training Certification (2021)
Developmental Sciences Teaching Institute, SRCD (2021)

Related Service
American Psychological Association’s Graduate Student Teaching Assistant Steering Committee Member (2023-present) and Incoming Chair (2024-2025).

Service and Mentorship
Ad Hoc Journal, Conference Proceedings, and Presentation Reviewing
Translational Issues in Psychological Science (Reviewer and Associate Editor)
Associate Editor for Special Issues on:
Social Cohesion and Social Change
Psychology in the Age of Technology

International Journal of Child-Computer Interaction
Cognitive Science
Cognitive Development
Computers and Human Behavior

Cognitive Science Annual Conference (CogSci)
Conference for Interaction Design and Children (IDC ACM)

University of Louisville Undergraduate Poster Symposium
Louisville Regional Science Fair

Service to the Field

Undergraduate Psychology Workshops, organizer and speaker, virtual series with
1500+ participants annually (2022-present)

R Ladies Panels and Workshops, organizer and speaker, virtual series with 2000+
participants (2022-present)

Application Statement Feedback Program, Editor (2023)

University Service
Graduate School Q&A Panel for Undergraduates, Psychological and Brain Sciences,
University of Louisville (Spring 2022 & Spring 2023)

Inclusive Teaching and Active Learning Workshop Leader, Professional Development
Programming, Graduate Network of Arts and Science, University of Louisville (2021-
present)

REACH training for undergraduate students, material generation, University of
Louisville (Summer 2022)

“First Gen Card” Program for first generation students, volunteer and mentor,
University of Louisville (2021-present)

Graduate Student Council, Student Representative, University of Louisville (2021-
2022)

Lab and Department Service
Graduate Professional Development Leader, Knowledge in Development Lab,
University of Louisville (Summer 2022)
Undergraduate Professional Development co-leader, Knowledge in Development Lab, University of Louisville (2021-2022)

Transition Ambassador Program (TAP) for first year students, co-founder, Department of Psychological and Brain Sciences, University of Louisville (2021-present)

Experimental Psychology Peer Mentorship Program, organizer and member, Department of Psychological and Brain Sciences, University of Louisville (2020-present)

Experimental Program Student Representative, Department of Psychological and Brain Sciences, University of Louisville (2020-2022)

Graduate School Informational Meeting, Graduate Student panel leader, University of Louisville (Fall 2021)

Community Service
R-Ladies Louisville Chapter, co-organizer and founder, Louisville KY (2022-present)

Louisville Pride Center, volunteer, Louisville KY (2023-present)

Change Today Change Tomorrow, volunteer, Louisville KY (2020-present)

Furman Connect Informational Interview Program, mentor, Greenville SC (2022-present)

Research Mentorship
Spring 2024  ACC Meeting of the Minds Oral Talk research mentor (Lou H)
Spring 2024  Undergraduate mentored research grant (Lou H)
Sum. 2023  Cognitive Development Society Mentor (Jordan L)
Fall 2022  Course Credit Independent Research Mentor (Ethan B)
Spring 2021  Course Credit Independent Research Mentor (Rachel A)
2020-2021  Undergraduate Honors Thesis Mentor (Hailey S)
Sum. 2020  Summer Research Opportunity Program (SROP) grant supervisor (Hailey S)
Spring 2020  Undergraduate mentored research grant (Hailey S)
2019-present University of Louisville: 36 undergraduate students and recent graduates

Science Communication

Service
Communicating Science Conference, Create-a-Thon Lead (2023-present)
Letters to a Pre-Scientist (2023-present)
Skype a Scientist (2022-present)
Communicating Science Conference, Logistics and Programming Liaison (2022-2023)
Communicating Science Conference, Logistics Committee Member (2021-2022)
Presentation

Publications
ComSciConversations Blog, Editor in Chief (2023-present)
CogBites Blog, Author (2023-present)
“Corners”, Society for the Teaching of Psychology’s TA Blog, Contributor (2023-present)

Training
Data Storytelling Workshop, Delphi Teaching Center, University of Louisville
Stories of Science- Science Communication Bootcamp
Purdue University Emerging Perspectives on Early STEM Learning, Development, and Education Workshop
  - Open Science and Data Management Practices
  - Talking About Your Research Program
UC-San Diego Extended Learning Certification: Science Communication
  - Science Writing 1 (Grade: A+, SUM 23)
  - The Art of Interviewing (Grade: A+, SUM 23)
  - Introduction to Nonfiction Blogging (Grade: A+, FA 23)
  - Nonfiction Children’s Book Writing (Grade: A+, SPR 24)
  - News and Feature Writing (Grade: A, SPR24)

Professional Memberships
Cognitive Development Society (CDS)
Cognitive Science Society (CSS)
Society for Research in Child Development (SRCD)
Midwestern Psychological Association (MPA)
American Psychological Association (APA)
Association for Psychological Science (APS)
Society for the Teaching of Psychology (STP)