Testing the Modality Effect in an Online Training of Virtual Workers: An Experiment Inspired by Social Distancing

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TESTING THE MODALITY EFFECT IN AN ONLINE TRAINING OF VIRTUAL WORKERS: AN EXPERIMENT INSPIRED BY SOCIAL DISTANCING

by

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A paper submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy
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The University of Texas at Tyler
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The University of Texas at Tyler
Tyler, Texas

This is to certify that the Doctoral Dissertation of
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for the Human Resource Development Ph.D. degree

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Dedication

This dissertation is dedicated to those who struggle with learning disabilities. I hope that I have led by example and inspired you not to let a disability keep you from living your dreams.

I dedicate my doctorate to my Daddy Bob (Lambert). You empowered me to reach this significant milestone when you challenged me to see that I am "smart enough." Thank you for believing in me when I did not believe in myself.
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In closing, I have a question for the student advisor at DeVry University, who said, "Janice will never finish her bachelor's degree." How do you like me now?
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On March 11, 2020, the World Health Organization declared the COVID-19 outbreak as a pandemic, and within 10 days, the Center for Disease Control and Prevention reported that all 50 U.S. states had confirmed cases of the virus. Facing a national mandate of social distancing, most U.S. workers needed training on how to use tools and technologies required to do their jobs virtually. As a result, HRD professionals needed to quickly transition their practice onto virtual platforms with the most effective strategies for delivering learning content. Research findings have evidenced the presence of the modality effect, which states that learning is more significant when educational material is received in an audio-visual format compared to a visual-only design (Mayer & Moreno, 1998; Moreno & Mayer, 1999). However, this finding is limited to posttests immediately following the intervention (Mayer, Dow, & Mayer, 2003; Tabbers, Martens, & van Merriënboer, 2004). This study sought to empirically test the modality effect in working and long-term memory by assessing recall of a treatment group \((n_{T1-tmt} = 162, n_{T2-tmt} = 122)\) and control group \((n_{T1-cntl} = 243, n_{T2-cntl} = 99)\) immediately following a two and one-half minute lesson and again one week later, respectively. \(t\) tests statistically and practically confirmed the presence of the modality effect at Time 1. The treatment group outperformed the control group at Time 2; however, the findings were practically insignificant.
Keywords: instructional technology, memory, modality effect, virtual training
Chapter 1 – Introduction

Background to the Problem

Coronavirus Disease 2019 (COVID-19) is a deadly respiratory disease that spreads easily from person-to-person (CDC, 2020). On March 11, 2020, the World Health Organization declared the COVID-19 outbreak as a pandemic, and within 10 days, the Center for Disease Control and Prevention reported that all 50 U.S. states had confirmed cases of the virus (CDC, 2020). In response to the pandemic, the Trump administration implemented a nationwide program, "15 Days to Slow the Spread," to prevent the circulation of COVID-19 through social distancing. The White House's social distancing direction urged Americans to abstain from gatherings of more than 10 people and to maintain six feet of distance from others. As the end of the "15 Days to Slow the Spread" program approached, President Trump extended the social distancing plea an additional 30 days, indicating that the initial forecast of the spread of the disease was underestimated (CDC, 2020).

Social distancing led to social interaction through electronic devices rather than in-person. Schools closed, all education was moved online, and employees were required to work from home (Maragakis, 2020). Instantly, social distancing, a term that most Americans had never heard of, became a part of daily language. Many cities, counties, and states implemented mandatory shelter-in-place orders and required organizations to shut-down unless they provided an essential service. With one day’s notice, millions of Americans became remote workers and online students. Facing at least six weeks of social distancing, a majority of these individuals needed training on how to use tools and technologies so that they could do their job or schoolwork virtually. The mandate to keep
six feet between people and to not have more than 10 people gathered did not make this type of training or any other necessary training possible using traditional in-person approaches. Thus, those often responsible for developing, designing, and delivering training, human resource development (HRD) professionals, needed to transition their training onto virtual platforms quickly. Time was of the essence for the instructional design of training that could be virtually delivered.

As time passed, it became apparent that the global crisis was not going to be short-lived. The International Labour Organization reported that “as of 22 April 2020, 81 per cent of employers and 66 per cent of own-account workers live and work in countries affected by recommended or required workplace closures” (ILO Monitor, 2020, p. 1). Bick, Blandin, and Mertens (2020) reported that employees who worked from home increased 27% between February and May, 2020 and that they found “the ratio of effective to potential home-based workers was 71.7 percent in May. This suggests that the majority of US workers that could work from home did so in May” (p. 3). By June, tech giants Facebook, Twitter, Square, and Slack announced decisions to make working from home the new normal (McLean, 2020). As of November, 2020, it was still unclear when a vaccine would be widely available. However, it became clear that moving forward, virtual training would be an expectation of HRD practitioners.

Instructional design is a core component of HRD (Li, 2016). For years, technology has been at the core of HRD delivery methods, and advancements in technology have allowed practitioners to expand opportunities for professional development (Li, 2016; Reeves & Reeves, 2015). Selecting the media, method, and strategies for delivering learning content is the core of designing training interventions
The most effective instructional technology approaches remain debated (Atkinson, 2002; Crooks, Cheon, Inan, Ari, & Flores, 2012; Pellas, 2018).

Statement of Problem

In the rapidly changing workplace, how HRD engages learning opportunities is advancing. As such, practitioners must know the most effective way to deliver training. Callahan (2010) stressed that HRD practitioners have leapt blindly into virtual training without “considering the implications of online learning” (p. 869). DeRouin, Fritzsche, and Salas (2004) noted that “because workplace e-learners have different needs and motivations than other types of learners, learner-controlled training may need to be designed differently in order to be successful” (p. 149). For example, the presentation modality in virtual training differs from that of face-to-face. Many scholars have researched instructional delivery modes. Notably, Penney (1980) proposed the “separate streams hypothesis” (p. 194) of the modality effect. The separate streams hypothesis indicates that information obtained aurally is processed in the memory differently than information gained visually. According to Penney (1989), the modality effect occurs when learning improves when the learning material is presented in an audio-visual representation compared to a visual-only format. Penney (1989) defined audio-visual as a visual tool such as an illustration, graph, diagram, or figure, accompanied by a verbal explanation of the visual. Visual-only is described as a visual tool such as an illustration, graph, diagram, or figure accompanied by printed text explaining the visual (Mayer & Moreno, 2002). Carney and Levin (2002) expressed that the visual tool should overlap the lesson content. Some empirical evidence confirms the modality effect (e.g., Brünken, Plass, & Leutner, 2004; Mayer & Moreno, 1998; Mayer & Moreno, 2002; Moreno &
Mayer, 1999; Mousavi, Low, & Sweller, 1995). Studies produced evidence that the opposite sometimes occurs in what is referred to as the reverse modality effect. The reverse modality effect occurs when learning improves with a visual-only presentation rather than an audio-visual presentation (Schüler, Scheiter, Gerjets, & Rümer, 2008). Many studies provide evidence of the reverse modality effect (Liu, Zhu, & Wu, 1992; Penney & Godsell, 1999; Tabbers, Martens, & van Merriënboer, 2004; Witteman & Segers, 2010). However, the conditions that promote the reverse modality effect are not widely known. Researchers believe that self-paced learning and complex learning material are the antecedents to the reverse modality effect; however, this hypothesis is not significantly supported (Crooks et al., 2012; Tabbers et al., 2004). The majority of the empirical research on the modality effect has focused on short-term memory recall, so little is known about the modality effect on long-term memory recall. The few studies on long-term memory recall were limited to the recall of lists and not of instructional material (Engle & Mobley, 1976; Glenberg, 1984; Greene, 1985; Greene & Crowder, 1986; Liu et al., 1992; Watkins & Watkins, 1977; Watkins & Watkins, 1980). As the modality effect remains contested, the most powerful way to deliver multimedia instruction is unclear. Welsh, Wanberg, Brown, and Simmering (2003) stated, “our review of the academic research on e-learning revealed the use of e-learning moving faster than our empirical understanding of e-learning (p. 256). Additional research is needed to clarify the most effective mode of delivery, according to HRD scholars and practitioners' responsibilities.
Purpose of the Study

Media coverage of the pandemic suggested that working and going to school virtually would continue for the foreseeable future. As such, online training and development may be the predominant mode of operation for HRD practitioners and, potentially, some organizations' preferred approach. The purpose of this study was to evaluate the modality effect by examining the effect that learning content presented in a visual-only format compared to an audio-visual form has on working, and long-term memory recall in the context of a virtual workplace tool training module presented to virtual employees.

Theoretical Framework

Two theoretical frameworks underpinned this study: Baddeley's working memory model and the separate streams hypothesis of the modality effect. The theoretical framework of Baddeley's working memory model (Baddeley & Hitch, 1974) has influenced applied psychology research and remained pivotal likely due to its simplicity, which has allowed for the development of the model (Baddeley, 2010; Repovs & Bresjanak, 2006). Baddeley's working memory model (2000) from Baddeley and Hitch (1974) working memory model theorized that information received from auditory sources and information obtained from visual sources are unequivocally processed differently. They are coded, rehearsed, and stored in the brain independently. It is widely accepted that rehearsal is needed for memory processing, such as repeating an address in one's head to commit the address to memory. Baddeley and Larsen (2007) speculated that auditory information automatically enters a rehearsal loop, but visual information must be recoded and voluntarily entered into the rehearsal loop. Thus, converting visual
information to auditory code has attention costs, making it unproductive (Larsen & Baddeley, 2003).

Acknowledging that audio and visual information is processed differently, the separate streams hypothesis (Penney, 1980) focused on the relationship between learner performance and instructional delivery mode. The correlation between improved learner performance and multimodal presentation is referred to as the modality effect (Leahy, Chandler, & Sweller, 2003). Underpinned by Baddeley's working memory model, the modality effect is an increase in learner performance when instructional material is presented in an audio-visual format (Gibbons, Velkey, & Partin, 2008; Leahy et al., 2003; Leahy & Sweller, 2011; Mousavi, Low, & Sweller, 1995; Rummer, Schwegge, Fürstenberg, Scheiter, & Zindler, 2011; Savoji, Hassanabadi, & Fasihipour, 2011; Tindall-Ford, Chandler, & Sweller, 1997; Tremblay, Parmentier, Guérard, Nicholls, & Jones, 2006).

**Research Hypotheses**

Baddeley's working memory model (2000) and the separate streams hypothesis of the modality effect provide a theoretical basis for the research hypotheses. Information is received in the brain through the senses, hearing, sight, smell, taste, and touch, and that information is briefly stored in the working memory until it is either lost or transferred to long-term memory (Baddeley, 2002). Baddeley theorized that information received through hearing is processed and placed in an audio store. The information gained through sight, smell, taste, and touch are processed and placed in a visuospatial store. It is assumed that rehearsal is necessary for information to be transferred into long-term memory. According to Baddeley's working memory model, rehearsal takes place in the
audio store. For information stored in the visuospatial store to be rehearsed, it must be manually converted to the audio store. This process is said to consume attention and energy.

Analogous to Baddeley’s working memory model, the modality effect’s separate streams hypothesis assumes two information stores in the working memory, audio, and visual. Rehearsal takes place in the audio store. Visual information must be converted to the audio store for rehearsal, requiring attention and energy, creating an overworked cognitive load. When visual information such as an illustration is accompanied by verbal information that does not need to be converted, the system is not overworked, thus improving learning, which creates the modality effect. The reverse modality effect has been observed, and researchers believe that it occurs when learning is self-paced or the lesson material is complex. The experiment intervention for the treatment group was not self-paced, and the lesson material was not complex, so it was hypothesized:

_Hypothesis 1: Virtual workers who receive training material in an audio-visual format will have better working memory recall than virtual workers who receive training material in a visual-only format as measured by a posttest assessment of Microsoft Teams functionality knowledge._

Based on the separate streams hypothesis, audio-visual information does not overload the cognitive system, allowing more information to enter long-term memory. For this reason and those stated above, it was hypothesized:

_Hypothesis 2: Virtual workers who receive training material in an audio-visual format will have better long-term memory recall than virtual workers who receive_
training material in a visual-only format as measured by a one-week posttest assessment of Microsoft Teams functionality knowledge.

Overview of the Design of Study

Qualtrics\textsuperscript{\textregistered} was used to develop and administer a survey design to collect data (Campbell & Stanley, 1963). Prescreening data were collected to identify the sample. Then, data were collected on two occasions to test working memory (T1) and long-term memory recall (T2). Participants were recruited through Amazon Mechanical Turk (MTurk\textsuperscript{\textregistered}), an online survey distribution platform connecting researchers with respondents. Researchers have reported MTurk\textsuperscript{\textregistered} as a reliable source when conducting repeated measures studies (Daly & Natarajaian, 2015; Strickland & Stoops, 2018).

First, the prescreening survey consisted of eight prescreening questions and five demographic questions derived from the U.S. Census Bureau (2019) and the Bureau of Labor Statistics (BLS, 2020a; 2020b) to identify the targeted sample frame of U.S. based virtual workers. After the sample frame was identified, the subjects were randomly assigned to the control group or treatment group using the R package, randomizr (Coppock, Cooper, & Fultz, 2019). Using the R package, pyMTurkR (Burleigh & Leeper, 2020) subjects in the sample frame were emailed an invitation to participate in the study. Participants of the treatment group received a basic Microsoft Teams training (material) via an audio-visual presentation (stimuli). The control group received the basic Microsoft Teams training (material) in a visual-only form (stimuli). Immediately after the intervention, participants in both groups were assessed for working memory recall (T1). One week later, participants received an email invitation to participate in the long-term memory recall evaluation (T2).
Once the data were collected, they were cleaned and evaluated for statistical assumptions. The statistical software package R® 4.0.3 was used to conduct the data analyses. The demographic data collected with the prescreening survey was used to evaluate the population's sample representativeness and confirm group equivalency. Independent samples t tests were conducted to assess group differences in recall assessment scores collected immediately after the training and again one week later.

**Significance of the Study**

The present study has significant implications for theory, research, and practice. This study contributes to Baddeley's working memory theory by using an experimental design to test the working memory of subjects who report no memory deficits in a pragmatic context. Baddeley characterized his working memory model as a learning theory yet, his research has been limited to second language learning and learning for individuals with acquired memory deficits (Baddeley, 2003; Baddeley, Gathercole, & Papagno, 1998; Baddeley, Vallar, & Wilson, 1987; Evans et al., 2000). The current study applied the learning theory to test subjects' working memory with normal memory function and reading ability. Second, this study contributes to the research in the field of HRD by considering the implications of delivery mode in virtual learning, evaluating how virtual learning may need to be designed, and developing an empirical understanding of the modality effect in virtual training and development (Callahan, 2020; DeRouin et al., 2004). This study contributes to instructional technology research by testing the impact of technology approaches in a virtual learning environment. It contributes to the research in the field of psychology by analyzing the effect that the senses sight and sound have on memory. The current study contributes to higher
education research by informing educators about the modality effect in virtual adult learning. Lastly, this study provides empirical data to help mitigate instructional delivery ambiguity and provide evidence-based instructional design recommendations for HRD scholars and practitioners.

Assumptions

It was assumed that the participants responded honestly to eight self-report questions (i.e., are you employed; are you currently working from home due to COVID-19, do you now, or have you ever, used the computer program Microsoft Teams; do you have permanent memory impairment from a traumatic brain injury, concussion, or stroke; do you suffer from Alzheimer's Disease or dementia; do you have dyslexia, dysgraphia, or a reading disorder; do you have attention deficit hyperactivity disorder; do you identify as autistic) without social desirability bias. Furr (2010) explained, "social desirability is the tendency for research participants to attempt to act in ways that make them seem desirable to other people" (p. 1395). Although internet surveys reduce the frequency of social desirability bias, concerns for bias were addressed by survey wording such as ensured anonymity, a reminder that there are no right or wrong answers, and the request to answer the questions to the best of the participant’s ability (Callegaro, 2008). Second, it was assumed that participants answered the assessment questions from memory without looking-up the correct answers. To mitigate this concern, test takers were asked to answer the questions from memory, and the time to complete the assessment was limited to five minutes, 30 seconds per question. The literature suggested that 30 seconds is ample time to answer a multiple-choice question while limiting the time to cheat

**Delimitations**

There were four delimitations to the study. First, the sample frame was limited to U.S.-based Amazon Mechanical Turk workers. Second, the study only focused on two delivery modes for training material (i.e., audio-visual and visual-only). These modes were selected because the study’s underlying theories require audio-visual delivery, and most self-paced learning modules involve reading on-screen text (Koroghlanian & Sullivan 2000; Leahy et al., 2003; Ranieri, Raffaghelli, & Pezzati, 2018). Third, the study was limited to one learning module. Fourth, the learning material covered the basics of Microsoft Teams, an online collaboration tool.

**Definition of Terms**

- Audio-visual, in the context of the modality effect, is an educational delivery format where the material that is to be learned is illustrated (graph, diagram, figure, picture), and the text that would accompany the illustration is presented verbally (Mayer & Moreno, 1998). See Appendix A for an illustrative example.

- Gaby Lambert is the researcher’s requester name on Amazon Mechanical Turk.

- Human resource development “is a mechanism in shaping individual and group values and beliefs and skilling through learning-related activities to support the desired performance of the host system” (Wang, Werner, Sun, Gilley, & Gilley, 2017, p. 1175).
• Instructional technology is "the theory and practice of design, development, utilization, management, and evaluation of processes and resources for learning" (Seels & Richey, 1994, p. 1).

• Long-term memory is "a vast store of knowledge and a record of prior events, and it exists according to all theoretical views" (Cowan, 2008, p. 324).

• Modality effect occurs when learner performance is increased due to instructional material that is presented in an audio-visual format compared to a visual-only presentation (Leahy et al., 2003; Leahy & Sweller, 2011; Mousavi et al., 1995; Tindall-Ford et al., 1997).

• Phonological refers to information aurally received (Baddely & Hitch, 1974).

• Phonological loop is the store and maintenance of aurally received information (Baddeley & Hitch 1974).

• Rehearsal is the term used to describe repeating information in one's mind as a form of committing the information to memory (Baddeley, 2000).

• Reverse modality effect occurs when learning is improved when the material is presented in a visual-only format compared to an audio-visual form (Crooks et al., 2012).

• Short-term memory is "the temporary storage of small amounts of material over brief periods of time" (Baddeley, 2010, p. R136).

• Social distancing means keeping “at least 6 feet (about 2 arms’ length) from other people who are not from your household in both indoor and outdoor spaces” (CDC, 2020, para. 2).
• Virtual training “refers to training done in a virtual or simulated environment, or when the learner and the instructor are in separate locations” (Training Industry, 2020, para. 1).

• Virtual workers are individuals who “work from home offices using modern technology to get things done” (Rozier, 2017, para. 4).

• Visuospatial refers to information the brain receives from the two senses, vision and space (Baddeley & Hitch, 1974). See Appendix A for an example.

• Visual-only in the context of the modality effect, visual-only is an educational delivery format where the information that is to be learned is presented in text (i.e., printed words) and may be accompanied by an illustration (i.e., diagram, graph, figure, picture; Mayer & Moreno, 1998). See Appendix A for an example.

• Visuospatial sketchpad is the working memory store for information received visually and spatially (Baddeley & Hitch, 1974).

• Working memory is "a limited capacity system allowing the temporary storage and manipulation of information necessary for such complex tasks as comprehension, learning, and reasoning" (Baddeley, 2000, p. 418).

Chapter Summary and Organization of the Dissertation

This dissertation is organized into five logical chapters. Chapter 1 presents the introduction and background to the problem, statement of the problem, the purpose of the study, theoretical frameworks, research hypotheses, overview of the design, significance of the study, assumptions, delimitations, definitions, and concluded with the organization of the dissertation. Chapter 2 contains a review of the literature relevant to the study. The topics include instructional technology, the modality effect, working, and long-term
memory, and hypotheses support. Chapter 3 describes the study's methods and design and included the population and sample, sample frame, sample representativeness, research design, pilot study, data collection procedures, data analysis procedures, validity, and limitations. Chapter 4 discusses the results of the study and includes support for sample representativeness; group comparisons are examined, descriptive statistics are reported, and statistical assumptions are addressed. Chapter 5 discusses the results from Chapter 4 and relevant literature. This chapter also details the implications to theory, research, and the fields of HRD and VHRD, higher education, instructional technology, and psychology. The chapter concludes with the limitations of the study and future research.
Chapter 2 – Literature Review

Introduction

In this chapter, instructional technology, the modality effect, and Baddeley’s working memory model are further defined. The literature review is organized into four sections. In the first section, virtual training in HRD with an emphasis on instructional technology is briefly reviewed. The second section discusses memory. Baddeley’s working memory model is defined, and relevant studies are examined. Working and long-term memory are explained, and opposing models identified. The third section elaborates on the modality effect, and relevant studies of working and long-term memory. The reverse modality effect is also considered. The fourth section provides support for the research hypotheses that were addressed in this study.

The University of Texas at Tyler, Robert R. Muntz Library computer system was accessed as the primary resource for peer-reviewed journal articles to conduct this literature review. The library’s “Swoop Search,” which searches all databases for keywords, was used. Google Scholar was explored as a subordinate resource. The databases “SAGEJournals,” “SpringerLink,” and “ScienceDirect” were also searched. The database “ProQuest Dissertations and Theses Global” was used to access dissertations that were reviewed as a means of finding relevant journal articles. The following search terms and combinations of these terms were applied: human resource development, HRD, instructional design, instructional technology, on-demand training, eLearning, virtual HRD, modality effect, reverse modality effect, working memory, long-term memory, working memory theory, and Baddeley working memory model. There were no date restrictions.
Virtual Training in HRD

Bennett (2009) suggested that technology research in the context of HRD is situated in the virtual HRD (VHRD) literature. Virtual HRD has been defined “as a media-rich and culturally relevant Web environment that strategically improves expertise, performance, innovation, and community building through formal and informal learning” (Bennett, 2009, p. 364). A review of the VHRD literature revealed that HRD scholars and practitioners were interested in virtual training (cf., Mutamba, 2017; Wootton & Stone, 2010). However, what works in online learning remains uninvestigated (Reio, 2015). Scholars agree that to move forward, HRD scholars and practitioners must take risks and push boundaries (Bennett, 2009; Mancuso, Chlup, & McWhorter, 2010). This involves being more involved in technology development and embracing instructional design (Fagan, 2014; Mutamba, 2017).

Instructional design is the methodology for developing training interventions and a fundamental competency of HRD professionals (Allen, 2006; Li, 2016). There are over 100 models used in instructional design (Allen, 2006). The instructional design literature is firmly established in many disciplines, making it challenging to embrace the field’s totality and perform an exhaustive review (Bodily, Leary, & West, 2019). Within the research hypotheses framework, the current literature review focused on instructional technology as it applies to HRD.

Instructional Technology

Instructional technology in HRD has been traced back to the 1940s (Rosenberg, 1982). Seels and Richey (1994) defined instructional technology as “the theory and practice of design, development, utilization, management, and evaluation of processes
and resources for learning" (p. 1). Demps (2008) examined the overlap between instructional technology and HRD and proposed that "the domain of utilization... can be served well by the theories and practices of HRD" (p. 56). Utilization is the "act of using the processes and resources for learning" (Seels & Richey, 1994, p. 46). Instructional technology has been extensively studied in recent years, and the body of literature is vast. The current literature review focused on the domain of utilization, specifically control group experiments conducted January 2019 – June 2020 that tested audio-visual technology's effects on learning outcomes.

A review of instructional technology in the HRD literature recounted various studies of theory (cf. Bierema & Hill, 2005; Short, Scully-Russ, Lehner, and Shuck, 2013) and literature reviews (cf. Hutchins & Bierema, 2013; Park, Jeong, & Ju, 2018). Congruent with the findings of Oh and Huang (2018), the literature is concentrated on conceptual frameworks, and "a relatively small number of articles included development and testing and refinement activities" (p. 270). Human resource development scholars are applying instructional technology (see Figure 1). Still, the HRD literature has not moved from "conceptualization to empirical implementations," as evidenced by the "absence of prolonged technology research engagement in HRD" (Oh & Huang, 2018, p. 271). Meanwhile, "educators have historically fretted over the difficulties inherent in establishing links between research and practice" (Richey, 1998, p. 7).
The Collaborative Institutional Training Initiative (CITI Program) is widely accepted by scholars to provide "ethics training to approximately 35,000 new learners per month" (Braunschweiger & Hansen, 2010, p. 4). The trainee has the option of audio-visual, "for learners who prefer a more dynamic visual presentation, with optional audio narration," or classic, "for learners who prefer a more static text-image format" (CITI, 2020).

Data from 15 randomized control group experiments, similar to the one proposed here, found statistically significant support ($p \leq 0.05$), and 12 studies reported practical support ($\eta^2 \geq 0.14$) that utilizing audio-video in instruction improved learning outcomes (Fay & Boyd, 2010; see Table 1). While many of the studies examined audio-visual technology in the education of children, four analyses of adult learners provided empirical evidence supporting the causal relationship between audio-visual learning material and learner achievement (Lin, 2019), technical drawing ability (Rohman, Sudjimat, Sugandi, & Nurhadi, 2019), retention (Selvakumar, Sivakumar, & Dapnine, 2020), and recall (Umutlu & Akpinar, 2020).

Several studies found that use of multimedia in college education improved learner performance. For example, Selvakumar et al. (2019) reported that students who learned videos and other technical resources ($n = 25, M = 15.24$) outperformed learners
who learned from lecture based format ($n = 25, M = 11.64$). Linn (2019) reported similar findings when they tested the effect of interactive digital books. Linn found that the treatment group ($n = 19, M = 83.68, SD = 8.95$) outperformed the control group ($n = 15, M = 73.33, SD = 19.15$) with a statistical and practical significant difference between the groups ($F[1,31] = 4.48, p = 0.04, \eta^2 = 0.134$). Rohman et al. (2019) also reported better learner performance when multimedia was incorporated into higher education learning. They found that the treatment group ($n = 22, M = 74.79, SD = 5.32$) outperformed the control group ($n = 23, M = 57.88, SD = 6.42$). The difference between the groups was statistically and practically significant ($F[1, 44] = 90.27, p < 0.05, \eta^2 = 0.68$). Similarly, Umutlu and Akpinar (2020) tested the difference in group means between learners who received material presented on animated slides with text followed by narration ($n = 15, M = 22.70, SD = 1.87$) and a group who received traditional classroom instruction ($n = 18, M = 19.70, SD = 2.29$). The difference between group means was statistically and practically significant ($F[1, 32] = 16.53, p < 0.05, \eta^2 = 0.35$). In a second analysis, animated slides with narration followed by text were presented to the treatment group ($n = 15, M = 21.70, SD = 2.65$) and the control group received traditional classroom instruction ($n = 18, M = 19.70, SD = 2.29$). These difference between group means was found to be statistically and practically significant ($F[1, 32] = 5.41, p < 0.05, \eta^2 = 0.15$).

Oh and Huang (2018) proposed that "scholarly activities ought to focus more on the 'design' and 'testing' of technological applications, tools, and artifacts, and their implementation and integration into the workplace for improving individual learning and organization performance" (p. 272). This study took a positive step toward closing this
gap in the HRD literature by examining the modality effect in the context of virtual workplace training. Before reviewing the modality effect, the underpinning theory, Baddeley's working memory model, will be discussed.
Table 1

*Instructional Technology Empirical Studies*

<table>
<thead>
<tr>
<th>Study</th>
<th>Subjects</th>
<th>Audio-Visual Online Treatment Group</th>
<th>Traditional Classroom Control Group</th>
<th>$F$</th>
<th>$p$</th>
<th>$\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atun &amp; Usta (2019)</td>
<td>Grade 6</td>
<td>20 18.55 4.80</td>
<td>21 14.29 6.21</td>
<td>6.00*</td>
<td>&lt; 0.05</td>
<td>0.13*</td>
</tr>
<tr>
<td>Bibi &amp; Nawz (2020)</td>
<td>Grade 10</td>
<td>30 20.30 2.53</td>
<td>30 17.07 3.76</td>
<td>15.20*</td>
<td>&lt; 0.05</td>
<td>0.21*</td>
</tr>
<tr>
<td>Bolatli &amp; Korucu (2020)</td>
<td>Grade 7</td>
<td>42 83.52 10.28</td>
<td>46 55.91 14.71</td>
<td>102.30*</td>
<td>&lt; 0.05</td>
<td>0.54*</td>
</tr>
<tr>
<td>Bursali &amp; Yilmaz (2019)</td>
<td>Grade 5</td>
<td>43 68.91 19.52</td>
<td>46 54.05 23.04</td>
<td>10.70*</td>
<td>&lt; 0.05</td>
<td>0.11*</td>
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<td>T1</td>
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<td>T3</td>
<td></td>
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</tr>
<tr>
<td>Edward et al. (2019)</td>
<td>Grades 10 &amp; 11</td>
<td>120 71.75 15.52</td>
<td>240 52.07 19.65</td>
<td>91.71*</td>
<td>&lt; 0.05</td>
<td>0.20*</td>
</tr>
<tr>
<td>Inal &amp; Korkmaz (2019)</td>
<td>Grade 4</td>
<td>20 29.60 11.49</td>
<td>20 21.80 12.14</td>
<td>16.26*</td>
<td>&lt; 0.05</td>
<td>0.10*</td>
</tr>
<tr>
<td>Lin (2019)</td>
<td>College</td>
<td>19 83.68 8.95</td>
<td>15 73.33 19.15</td>
<td>4.48</td>
<td>&lt; 0.05</td>
<td>0.13</td>
</tr>
<tr>
<td>Rohman et al. (2019)</td>
<td>College</td>
<td>22 74.97 5.32</td>
<td>23 57.88 6.64</td>
<td>90.27*</td>
<td>&lt; 0.05</td>
<td>0.68*</td>
</tr>
<tr>
<td>Sahin &amp; Yilmaz (2020)</td>
<td>Grade 7</td>
<td>50 81.69 10.89</td>
<td>50 67.98 13.62</td>
<td>30.91*</td>
<td>&lt; 0.05</td>
<td>0.24*</td>
</tr>
<tr>
<td>Selvakumar et al. (2019)</td>
<td>College</td>
<td>25 15.24 2.05</td>
<td>25 11.64 1.89</td>
<td>41.67*</td>
<td>&lt; 0.05</td>
<td>0.46*</td>
</tr>
</tbody>
</table>
Table 1 (Continued)

*Instructional Technology Empirical Studies*

<table>
<thead>
<tr>
<th>Study</th>
<th>Subjects</th>
<th>Audio-Video Online Treatment Group</th>
<th>Traditional Classroom Control Group</th>
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<tr>
<td></td>
<td></td>
<td>(n \quad M \quad SD)</td>
<td>(n \quad M \quad SD)</td>
<td>(F)</td>
<td>(p)</td>
<td>(\eta^2)</td>
</tr>
<tr>
<td>Selvakumar et al. (2020)</td>
<td>Grade 9</td>
<td>30 (57.67 \quad 1.90)</td>
<td>30 (50.50 \quad 2.25)</td>
<td>177.83*</td>
<td>&lt; 0.05</td>
<td>0.75*</td>
</tr>
<tr>
<td>Umutlu &amp; Akpinar (2020)</td>
<td>College</td>
<td>15 (22.70 \quad 1.87)</td>
<td>18 (19.70 \quad 2.29)</td>
<td>16.53*</td>
<td>&lt; 0.05</td>
<td>0.35*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15 (21.70 \quad 2.65)</td>
<td>18 (19.70 \quad 2.29)</td>
<td>5.41*</td>
<td>&lt; 0.05</td>
<td>0.15*</td>
</tr>
</tbody>
</table>

*Note.* Bursali & Yilmaz (2019) collected data at three points in time. Umutlu & Akpinar (2020) had two control groups.

*values calculated because they were not reported. **values calculated differently from values reported.*
Memory

Hultberg, Calonge, and Lee (2018) stated that "the objective of instructional design is to control the cognitive load of the learner's working memory, to allow for the required capacity to process information and transfer it to long-term memory" (p. 28). The following section provided a historical narrative of the formation of the multistore memory system and presented a synthesis of the literature regarding this study's theoretical basis.

Baddeley’s Working Memory Model

The dichotomy of memory into two stores, short-term and long-term, was proposed in 1949 by Hebb (Adams, Nguyen, & Cowan, 2018; Baddeley, 2003). Hebb hypothesized that long-term memory resulted from permanent changes in the nervous system, and short-term memory involved temporary electrical activity (Baddeley, 2003). There was epic activity in experimental psychology during this time, predominantly on the attention and decision processes. This period became known as the cognitive revolution (Malmberg, Raaijmakers, & Shiffrin, 2019). Considerable experimental research by Miller (1956), Brown (1958), Peterson and Peterson (1959), and Melton (1963) offered support for the hypothesis that there were two distinct types of memory: short-term and long-term (Baddeley, 2003). The first memory model representing both stores was introduced with Broadbent’s (1958) filter model of attention (Lachter, Forster, & Ruthruff, 2004). Over the next decade, methodologists worked to define a theory of a dichotomous system. The most influential model was presented by Stanford University scholars Atkinson and Shiffrin in 1968 (Baddeley, 2003).
Parallel to the heightened interest in the study of a two-storage memory system, working memory was first mentioned in the literature in 1956 when Newell and Simon used the term to explain the computer processing system (Adams et al., 2018). Miller, Galanter, and Pribram introduced working memory to the cognitive sciences in 1960 when they presented the concept in human research (Adams et al., 2018). Miller and his colleagues proposed that working memory is a cognitive process that allows humans to function effectively by storing information needed to complete their goals and subgoals (Adams et al., 2018). Adams et al. (2018) provided an example of the process as “the goal of furthering one’s career can have a subgoal of getting an academic degree, with a sub-subgoal of making it to class today, a sub-subgoal of getting dressed, and so on, down to one's momentary activities” (p. 341). Baddeley and Hitch (1974) gave impetus to the study of working memory when they presented unambiguous evidence for the presence of a working memory system that played a crucial role in human information processing.

A comprehensive review of the existing literature did not provide a standard definition of working memory. This finding is congruent with Cowan’s (2017) literature review that highlighted nine definitions of working memory. Baddeley’s (2000) interpretation was adopted to support the research hypotheses of the current study; “a limited capacity system allowing the temporary storage and manipulation of information necessary for such complex tasks as comprehension, learning and reasoning” (p. 418). Since the 1970s, “the concept of working memory has been increasingly widely used, extending from its origin
in cognitive psychology to many areas of cognitive science and neuroscience, and been applied within areas ranging from education, through psychiatry to paleoanthropology” (Baddeley, 2010, p. R136).

Baddeley’s working memory model was theoretically underpinned by the Broadbent (1956) and Atkinson and Shiffrin (1956) models of short-term memory (Baddeley, 2000). Like Atkinson and Shiffrin, Baddeley and Hitch (1974) viewed their model as learning theory (Baddeley, 2010; Baddeley et al., 1998; Baddeley & Hitch, 1974; Baddeley, Papagno, & Vallar, 1988; Baddeley et al., 1975).

Drawing on Shallice and Warrington's (1970) work, Baddeley and Hitch (1974) conducted a study to answer two research questions. First, “is there any evidence that the tasks of reasoning, comprehension, and learning share a common working memory system” (p. 49)? Second, “if such a system exists, how is it related to our current conception of STM” (short-term memory; p. 49). They performed a series of 10 experiments that examined verbal reasoning, language comprehension, and free recall of unrelated words with varying cognitive load levels. Subjects were asked to memorize a series of digits or words and repeat the sequence to the experiment observer. The results indicated a considerable deficiency in performance with a memory load of six items, but little to no effect with a load of three items. Their results were congruent with those of Shallice and Warrington and strongly advocated for the support of a working memory system unique to long-term memory. To rationalize their findings, Baddeley and Hitch abandoned the one-component theories of Broadbent and Atkinson and Shiffrin and proposed a three-component model (Baddeley, 2010).
Their multicomponent model took into account the research of Craik and Lockhart (1972) and accentuated that the memory system is a complex cognitive process rather than a memory in isolation, as depicted in the influential models (Baddeley, 2000; Baddeley, 2010). This thinking disagreed with Atkinson and Shiffrin’s “assumption of a series of successive stages for a model capable of parallel processing across the subsystems” (Baddeley 2010, p. R137).

Baddeley and Hitch’s (1974) working memory model presented three components (see Figure 2). In the center, the central executive represented the attentional control, which was first introduced in Broadbent’s selective filter theory. The model has two subsystems, also referred to as slave systems: the phonological loop and the visuospatial sketchpad. The phonological loop functions as the store and maintenance of aurally received information. The visuospatial sketchpad operates as the store and maintenance of visually and spatially received information. Several studies authenticate the modular existence of a phonological subsystem and visuospatial subsystem (Burgess & Hitch, 1992; Fang, Hu, Yang, & Liu, 2020; Miyake & Shah, 1999). Similar to Atkinson and Shiffrin (1958), Baddeley and Hitch (1974) proposed that subvocal rehearsal was essential to preserve information. The following sections expound on Baddeley’s working memory model's components starting with the central executive, followed by the phonological loop, visuospatial sketchpad, and conclude with the episodic buffer.
The central executive. The central executive was initially created in ambiguous terms as a restricted capacity pool of general processing means (Baddeley, 2002). Although the central executive is the most important component in the working memory framework, it remained the least understood for the first decade of the working memory model (Baddeley, 1996; Baddeley, 2002). Adopting Norman and Shallice’s (1986) supervisory attention subsystem model to inform their research, Baddeley and his colleagues began concentrating on the central executive's attentional control characteristics (2002). The purpose of the central executive is attention capacity, working memory, and switching attention.

Baddeley, Lewis, Eldridge, and Thomson (1984) carried out a series of experiments where a challenging secondary task was enacted on the subject while learning lists of words. They found that retrieval from long-term memory does not depend on the central executive. However, the secondary task had an unequivocal effect on learning but not on recall (Baddeley et al., 1984). They
concluded that the capacity to focus and attentional capacity are essential features of the central executive. Craik, Govoni, Naveh-Benjamin, and Anderson (1996) replicated Baddeley et al. (1984) and further discovered that although the secondary task did not affect recall, the process of recall did disrupt the performance of the secondary task. This also lends support that attentional capacity is an essential feature of the central executive.

The findings of Baddeley et al. (1984) led Baddeley and an extensive research team to explore the effect of tasks that aimed to disrupt the audio loop, the visual sketchpad, and the central executive, as described by Robbins et al. (1996). Their findings suggested that the central executive did not have a function in verbal working memory. However, the central executive played a significant role in visuospatial working memory (Robbins et al., 1996).

From there, Baddeley, Chincotta, and Adlam (2001) performed a series of experiments using dual tasks to investigate the role working memory plays in task switching. While they found support for the hypothesis that the central executive has a function in switching attention, the data suggested switching is more influenced by the phonological loop. Baddeley et al. (2001) stated that the outcome enlightened them to the phonological loop's contribution to controlling action.

The phonological loop and the visuospatial sketchpad. According to Baddeley (2000), “the phonological loop is probably the best-developed component of the working memory model” (p. 419). Originally named the articulatory loop, it was renamed since storage capacity was the central feature of
the component, which can function without articulation when information is presented aurally (Baddeley & Larsen, 2007). The phonological loop serves as a temporary store and an articulatory rehearsal system (Baddeley & Larsen, 2007). A blend of various studies informs the verbal component. Murray (1968) experimented with subjects who repeatedly voiced a sound to prevent rehearsal. The results indicated that verbal memory was affected by articulatory suppression, which supported the need for the rehearsal loop. Baddeley, Thomson, and Buchanan (1975) evidenced the audio store's presence with experimental research that focused on the effect of similar-sounding words and phrases (Baddeley & Larsen, 2007). The importance of subvocal repetition was established by studies that demonstrated that as the length of the words to be remembered increased, immediate recall declined (Baddeley, 2010).

The visuospatial sketchpad is believed to be capable of temporarily storing and manipulating visuospatial information (Baddeley, 2002). The sketchpad stores a range of visual information sources, including motor, physical, touch, smell, and taste (Baddeley, 2010). Baddeley and Larsen (2007) discovered that “when material is presented visually, subvocalization is assumed to be necessary for registering the material in the phonological store” (p. 498). However, auditory material is registered to the phonological store automatically (see Figure 2). This theoretical perspective is significant to the current research hypotheses. Several experiments by Larsen and Baddeley (2003) questioned what effect similar-sounding words, irrelevant speech, tapping, and articulatory suppression delivered at various rhythms had on immediate serial recall. They established that when
information is presented in text, suppression eliminated the effect of similar-sounding words. Larsen and Baddeley assumed that this was because suppression prevented visually presented letters from being converted to the rehearsal loop. When visual information enters the visuospatial sketchpad, the data has to be converted to audio code and transferred to the rehearsal loop as evidenced by studies performed in the 40 plus years since the introduction of the model (Burgess & Hitch, 1992; Burgess & Hitch, 2006; Fang et al., 2020).

Furthermore, Larsen and Baddeley (2003) suggested that converting visual information to the audio code had an attentional cost, making it unproductive. Since it is a voluntary process, it was likely to be abandoned. Perhaps this is why performance is typically better with auditory than visual presentation (Baddeley & Larsen, 2007). Baddeley (2002) acknowledged the difficulty in providing a narrative of the rehearsal in the visuospatial sketchpad. Evidence for an output process comparable to vocalization has yet to be established.
Figure 3. Phonological Loop Model. A detailed model of the phonological loop. Adapted from “Working Memory,” by A. D. Baddeley, 2010, Current Biology, 20, p. R139. Copyright 2010 by Elsevier Ltd. Reprinted with permission (see Appendix B).

Baddeley et al. (1987) questioned prose recall. The data showed that when participants were asked to repeat a sequence of unrelated words, on average, they would error once the number of words exceeded five or six. Further, when the same participants were asked to recall words that comprised a meaningful sentence, subjects could recall a sentence of 16 words or more successfully. Miller (1956) identified this as chunking. It is hypothesized that words are integrated into chunks, and memory capacity is determined by the number of chunks instead of the number of words (Baddeley, 2000). Cowan (2008) suggested that healthy brains can recall an average of four to six chunks. Research by Vallar and Baddeley (1984) revealed that a person with a memory deficit who had a word span of one had a sentence span of five. This indicated
that chunks are not stored in the phonological store. Furthermore, his research suggested that to form these episodes, there must be some sort of interaction between the phonological loop and long-term memory (see Figure 3).


According to Baddeley (2000), the model was revised to add a two-way link between the auditory rehearsal loop and long-term language. An additional two-way link was added between visuospatial sketchpad and long-term memory visual semantics. The shaded portion of the model represented the system of long-term memory, and the unshaded area represents attention and temporary storage (see Figure 4). Still, Baddeley questioned where the episodes are stored. Baddeley hypothesized that the subsystems’ information is integrated into episodes (or chunks) in an episodic buffer (Baddeley, 2000).

**Episodic buffer.** The episodic buffer represents a “storage system using a multimodal code. It is assumed to be episodic in the sense that it holds integrated episodes or scenes and to be a buffer in providing a limited capacity interface between systems using different codes” (Baddeley, 2002, p. 92). It is theorized
that the buffer is a temporary crossing point between working memory and long-term memory. Baddeley (2000) advised that the central executive controls the buffer component (see Figure 5). As a result, the function of the buffer is considered to be taxing on attention. It is believed that the buffer has a limited capacity of approximately four chunks that are available through conscious awareness (Baddeley, 2010). It is surmised that the buffer plays an active role in binding information while serving as a passive store. A competitive theory, Cowan’s working memory model (Cowan, 1988, 1995, 1999, 2001), agreed with Baddeley on the episodic buffer’s proposed concept. Beyond memory storage and recall, Baddeley (2000) suggested that the buffer is a space where new cognitive representations are created that can facilitate problem-solving. The previous versions of the model ignored the phenomena of assimilating information from multiple sources. The emergence of the episodic buffer component provided the theoretical framework to suggest a connection between information source and memory recall.
Engle (2002) hypothesized that, “the difference between high and low span subjects in working memory capacity tasks is due to differences in mental effort” (p. 15). Engle’s theory simply states that increased working memory
capacity is achieved by those who try harder. His approach stressed the role of inhibition to silence noise from extraneous information. Engle’s theory only addressed visual information processing, whereas Baddeley and Hitch (1974) explained the processing of visual information separately from audio data.

Just and Carpenter (1992) theorized that individual differences in the level of comprehension processes, vocabulary size, and personal motivation influence memory capacity. Similar to Engle, Just and Carpenter noted the importance of attention and inhibition. Just and Carpenter’s study of working memory focused on language comprehension. Their theory addressed the processing of verbal information but neglected to address the processing of visual information.

Cowan’s (1995) model is the most consistent with Baddeley (2000). Perhaps the only difference between the theories is the coding of information. In Cowan’s model, coding takes place in the long-term memory store. Baddeley proposed that coding occurs in the episodic buffer where data from multiple sources is combined into episodes. After a review of the literature, it is evident that Baddeley’s (2000) working memory model provides the ideal theoretical framework for the current study for three reasons:

1. Phonological and visuospatial information is unequivocally coded, rehearsed, and stored differently and independently (Baddeley & Hitch, 1974).

2. The episodic buffer is a component where information from the audio and visual systems can be combined in a module that serves as an interface between working memory and long-term memory (Baddeley, 2000).
3. While audio information automatically enters a rehearsal loop, visual information must be converted and voluntarily entered into the rehearsal loop (Baddeley & Larsen, 2007). Thus, converting visuospatial information to phonological code has attention costs, making it unproductive (Larsen & Baddeley, 2003).

Support for the study of memory recall when information is delivered in audio and visual formats falls under the theoretical framework of Baddeley’s (2000) working memory model. However, the literature for this body of research resides in the education domain, specifically in the subject matter, the modality effect.

The Modality Effect

The modality effect proposes that “learning will be enhanced if textual information is presented in an auditory format, rather than the usual visual format, when accompanying related visually based information, such as a graph, diagram or animation” (Ginns, 2005, pp. 314-314). For example, Figure 6 illustrates the visually based information used to supplement the auditory format and the usual visual format (text) in Main and Griffiths's (1977) study. Participants in the audio-visual group listened to a narrative explaining what was being depicted in the illustration. Likewise, participants in the visual-only group read about what was being presented in the diagram.
Figure 6. Supplemental Visual Information. Supplemental visual information is used to accompany audio format and usual visual format in a meteorology lesson. From “Evaluation of Audio and Pictorial Instructional Supplements,” by R. E. Main and B. Griffiths, 1977, AV Communication Review, 25, p. 172. Copyright 1977 by JSTOR. Reprinted with permission (see Appendix B).

A review of the modality effect literature, without date restrictions, identified 15 quantitative studies published in peer-reviewed journals. The studies were examined for sample age first. The six studies with samples under the age of 18 were not further reviewed (Jeung, Chandler, & Sweller 1997; Kalyuga, Chandler, & Sweller, 1999; Leahy et al., 2003; Levin & Devine-Hawkins, 1974; Mann, Newhouse, Pagram, Campbell, & Schulz, 2002). The remaining nine studies were reviewed for sample size, practical, and statistical significance. Practical significance was determined by $\eta^2$ of 0.14 or higher (Fay & Boyd, 2010). When effect sizes were not reported or the test results were not confirmed, eta-squared was calculated as $\eta^2 = \frac{F\times df\text{Between}}{F\times df\text{Between} + df\text{Error}}$ (Bohannon, 2015; Freese & Peterson, 2017). Statistical significance was determined by $p < 0.05$ (Fisher, 1925).
In this literature review, it is essential to be mindful that the modality effect occurs when learning increases from learning material that is presented in audio-visual format compared to a visual-only form. Audio-visual is defined as an illustration, picture, graph, chart, or drawing accompanied by an oral explanation. Visual-only is defined as an illustration, picture, graph, chart, or drawing paired with text. The learner has to switch between reading and reviewing the illustration. The following synthesized the findings of nine empirical studies of the modality effect.

A review of the literature revealed that empirical studies of the modality effect are contradictory (see Table 2). The duration of the intervention ranged from two and a half to 47 minutes. Upon closer examination, the studies that did not find significant main effects deviated from the modality effect's fundamental characteristics. For example, Atkinson (2002) incorporated an animated character to give instruction either through text \((n = 19)\) or aurally while using animation to direct learner focus \((n = 18)\). Tabbers et al. (2004) tested the causal effect of visual cues in the modality effect by testing with and without cues in the diagram. Unfortunately, the visual cue was not defined in the study. Taken in context, “visual cues that related the right elements in the picture to the accompanying spoken text” (Tabbers et al., 2004, p. 73) left the reader to interpret visual cues. Without a clear understanding of how audio-visual and visual-only were altered, it is difficult to interpret the study results. Considering the preceding, studies that adhered to the modality effect's fundamentals found significant evidence for the main effects (Mayer and Moreno, 1998; Moreno & Mayer, 2002; Moreno, Mayer,
Spires, & Lester, 2001; see Table 2). However, the four studies that evidenced the modality effect had relatively small sample sizes (cf. Raudys & Jain, 1991; Slavin & Smith, 2008). The sample size is a fundamental element of the experimental design. There are three substantial risks associated with data collected from a small sample size, including (a) not being representative of the population, (b) not finding a real effect due to low statistical power, and (c) findings that cannot be replicated (Acheson, 2010).
### Table 2

**Empirical Studies of the Modality Effect**

<table>
<thead>
<tr>
<th>Study</th>
<th>Lesson Material</th>
<th>Audio-Visual</th>
<th>Visual-Only or Control</th>
<th>F</th>
<th>p</th>
<th>$\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atkinson (2002)</td>
<td>Algebra</td>
<td>7.20 3.35</td>
<td>5.88 4.00</td>
<td>1.60*</td>
<td>0.18*</td>
<td>0.03*</td>
</tr>
<tr>
<td>Gyselinck et al. (2008)</td>
<td>Inverters</td>
<td>28 11.18 2.23</td>
<td>28 11.11 2.04</td>
<td>0.02*</td>
<td>0.39*</td>
<td>&lt; 0.01*</td>
</tr>
<tr>
<td>Mayer et al. (2003)</td>
<td>Mechanic</td>
<td>26 8.43 2.56</td>
<td>52 6.54 2.22</td>
<td>11.33*</td>
<td>&lt; 0.01*</td>
<td>0.13*</td>
</tr>
<tr>
<td>Mayer &amp; Moreno (1998)</td>
<td>Weather</td>
<td>40 0.69 0.18</td>
<td>38 0.52 0.19</td>
<td>16.47**</td>
<td>&lt; 0.01</td>
<td>0.18*</td>
</tr>
<tr>
<td>Moreno &amp; Mayer (1999)</td>
<td>Weather</td>
<td>58 10.67 2.82</td>
<td>60 8.03 3.28</td>
<td>21.54**</td>
<td>&lt; 0.01</td>
<td>0.16**</td>
</tr>
<tr>
<td>Moreno &amp; Mayer (2002)</td>
<td>Weather</td>
<td>17 6.53 1.77</td>
<td>17 5.65 1.87</td>
<td>0.90</td>
<td>0.41</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13 7.23 1.69</td>
<td>13 5.77 1.74</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>13 6.85 0.80</td>
<td>14 4.86 2.38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moreno et al. (2001)</td>
<td>Botany</td>
<td>33 8.12 0.96</td>
<td>31 7.10 1.70</td>
<td>8.87**</td>
<td>&lt; 0.01</td>
<td>0.13*</td>
</tr>
<tr>
<td>Tabbers et al. (2004)</td>
<td>Course design</td>
<td>56 29.40 5.00</td>
<td>55 32.80 5.20</td>
<td>12.32**</td>
<td>&lt; 0.01</td>
<td>0.10*</td>
</tr>
<tr>
<td>Tindall-Ford et al. (1997)</td>
<td>Circuits</td>
<td>10 1.20 1.10</td>
<td>10 1.40 0.80</td>
<td>1.91</td>
<td>0.17*</td>
<td>0.12*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 1.50 0.70</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. Moreno and Mayer (2002) had three audio-visual groups and three visual-only groups. Tindall-Ford et al. (1997) had three groups. *values calculated because they were not reported. **values calculated differently from values reported. All samples were college students.*
Long-Term Modality Effect

Perhaps the most confusing part of the study of the long-term modality effect is the inconsistency in how researchers define long-term memory. Cowan (2008) defined long-term memory as “a vast store of knowledge and a record of prior events, and it exists according to all theoretical views; it would be difficult to deny that each normal person has at his or her command a rich, although not flawless or complete, set of long-term memories” (p. 324). Scholars agree that information that is not lost in the working-memory is transferred to long-term memory (Baddeley, 2002; Ricker, 2015; Shiffrin & Atkinson, 1969). How long this process takes is debated. Baddeley (2002) estimated approximately two seconds, Ricker (2015) vaguely stated a matter of seconds, and Shiffrin and Atkinson (1969) proposed 30 seconds. Based on the literature, information that is recalled after 30 seconds is likely stored in long-term memory. This may not be the case. Baddeley’s working memory model theorized that rehearsed information is refreshed and therefore remains in the working memory for longer (Baddeley, 2002). The literature supports the duration of two to 30 seconds between the intervention and the long-term memory assessment in each study outlined in Table 3.

Most of the long-term modality effect studies do not fall within the scope of the current study. As shown in Table 3, research focuses on the long-term retention of words to measure the modality effect in long-term memory using recall as the dependent variable (Engle & Mobley, 1976). In these studies, a list of words or word pairs were presented to the subjects, one at a time. Each word
or word pair would display on a screen for approximately two seconds, with one to two seconds of a blank screen in between. One group would only see the word while the other group would hear the word in addition to seeing it on the screen. Empirical evidence has supported the claim that items remain in working memory until they are replaced with new substances. The working memory capacity is only four chunks of information (Baddeley & Hitch, 1974; Baddeley & Larsen, 2007). For example, assume that the word “house” appears on the screen, followed by a blank screen. A second later, the term “brick” displays, followed by a blank screen. This process continues for 30 words.

According to Baddeley’s working memory theory (2001), two things occur. First, the term “brick” replaces the word “house” in the working memory. Second, the working memory does not have the capacity for all 30 words. Therefore, words retained before words 27, 28, 29, and 30 must be stored in long-term memory. The duration of the interventions ranged from less than one minute to under two minutes. To add rigor to a study of long-term memory recall, distractors are often added. As discussed in Baddeley’s working memory model, the working memory is dependent on attentional control. Adding a distractor puts more stress on the working memory, which adds support that information recalled is from long-term memory.

In the studies reviewed in Table 3, subjects were asked to work on a simple addition or subtraction problem before recalling the list of words. A variety of data collection procedures were employed. Engle and Mobley (1976) used free written recall allowing subjects 60 seconds to five minutes to write down as many of the
words as possible. Segers, Verhoeve, Hulstijn-Hendrikse, and Perfetti (2008) used a written Likert-scale survey, and Witteman and Segers (2009) collected data using a computer-based questionnaire with open-ended questions. Engle and Mobley (1976) provided statistical evidence of the modality effect in long-term memory recall with a 60-second delay before testing. This literature review revealed that little is known about the modality effect in long-term memory recall of adults.
### Table 3

**Empirical Studies of Long-Term Modality Effect**

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample</th>
<th>Lesson Material</th>
<th>Time Delay</th>
<th>Audio-Visual</th>
<th>Visual-Only</th>
<th>F</th>
<th>p</th>
<th>η²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engle &amp; Mobley (1976)</td>
<td>Adult</td>
<td>Words</td>
<td>60 sec.</td>
<td>36</td>
<td>36</td>
<td>6.56</td>
<td>0.02</td>
<td>0.09</td>
</tr>
<tr>
<td>Segers et al. (2008)</td>
<td>Children</td>
<td>Energy</td>
<td>1 week</td>
<td>26</td>
<td>18</td>
<td>4.90</td>
<td>&lt;0.01*</td>
<td>0.40*</td>
</tr>
<tr>
<td>Witteman &amp; Segers (2009)</td>
<td>Children</td>
<td>Weather</td>
<td>1 week</td>
<td>40</td>
<td>40</td>
<td>3.73</td>
<td>0.09*</td>
<td>0.38</td>
</tr>
</tbody>
</table>

*Note. * values calculated because they were not reported. **values that were calculated differently from the values that were reported.
Reverse Modality Effect

The reverse modality effect occurs when learning is better with a visual-only presentation than an audio-visual presentation (Schüeler et al., 2008). The conditions of the reverse modality effect are not widely known; two conditions seem to be relevant, (1) self-paced learning and (2) complex learning material (Crooks et al., 2012; Tabbers et al., 2004). This literature review discovered four empirical studies that hypothesized a reverse modality effect (see Table 4). The duration of the intervention ranged from four to 20 minutes. The analyses yielded inconsistent results. Crooks et al. (2012) and Inan et al. (2015) reported significant support for the reverse modality effect for recall, matching, and comprehension for complex learning material. Schüeler et al. (2008) and van den Broek, Segers, and Verhoeven (2014) were not able to support the presence of a reverse modality effect when the learning material contained long-text passages or was learner-paced. In practical terms, the information provided by Schüeler et al. indicated evidence of the modality effect.

One modality effect study reviewed earlier provided evidence of the reverse modality effect (Tabbers et al., 2004). Scholars have hypothesized the cause of the reverse modality effect, but the variables associated with the reversal remain unidentified. While the studies reviewed here provide significant support of the reverse modality effect, none of them reported practical significance ($\eta^2 \geq 0.14$; Fay & Boyd, 2010). Fay and Boyd (2010) warned that significance is not strong when the sample is less than 50. The current literature does not practically support the existence of the reverse modality effect.
Table 4

Empirical Studies of the Reverse Modality Effect

<table>
<thead>
<tr>
<th>Study</th>
<th>Measure</th>
<th>Lesson Material</th>
<th>Audio-Visual</th>
<th>Visual-Only</th>
<th>F</th>
<th>p</th>
<th>η²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>n  M  SD</td>
<td>n  M  SD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crooks et al. (2012)</td>
<td>Recall</td>
<td>Complex</td>
<td>62 9.72 5.37</td>
<td>73 12.35 7.65</td>
<td>5.16**</td>
<td>0.03</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>Match</td>
<td>Complex</td>
<td>62 2.83 1.95</td>
<td>73 3.89 2.64</td>
<td>6.83**</td>
<td>&lt; 0.01</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>Comp</td>
<td>Complex</td>
<td>62 6.97 2.38</td>
<td>73 8.12 2.72</td>
<td>6.71**</td>
<td>0.01</td>
<td>0.05</td>
</tr>
<tr>
<td>Inan et al. (2015)</td>
<td>Match</td>
<td>Complex</td>
<td>72 2.65 2.25</td>
<td>79 3.76 2.77</td>
<td>7.22</td>
<td>0.01</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>Comp</td>
<td>Complex</td>
<td>72 6.40 2.92</td>
<td>79 7.61 2.98</td>
<td>6.33*</td>
<td>0.02**</td>
<td>0.04**</td>
</tr>
<tr>
<td>Schüeler et al. (2008)</td>
<td>Control</td>
<td>Long</td>
<td>21 31.95 14.44</td>
<td>20 22.30 11.44</td>
<td>5.36*</td>
<td>0.03*</td>
<td>0.12*</td>
</tr>
<tr>
<td>van den Broek et al. (2014)</td>
<td>Retention</td>
<td>Self-paced</td>
<td>43 0.55 0.24</td>
<td>41 0.54 0.21</td>
<td>6.11*</td>
<td>0.02*</td>
<td>0.07*</td>
</tr>
<tr>
<td></td>
<td>Transfer</td>
<td>Self-paced</td>
<td>43 0.52 0.19</td>
<td>41 0.47 0.16</td>
<td>3.56*</td>
<td>0.07*</td>
<td>0.04*</td>
</tr>
</tbody>
</table>

Note. Comp = comprehension. Match = matching. *values calculated because they were not reported. **values calculated differently from the values reported.
Hypotheses

Baddeley’s working memory model assumes that attentional control, served by short-term visual substance storage, and short-term audio content storage, makes up working memory (Baddeley, 2010). Information remains in the working memory until it is either lost or transferred to long-term memory. Building on Baddeley’s theory, studies of the modality effect have established that learning recall is increased when the training material is delivered in an audio-visual presentation when compared to a visual-only presentation (Leahy et al., 2003; Mousavi et al., 1995; Tindall-Ford et al., 1997).

Baddeley theorized that the phonological loop serves as a temporary store and an articulatory rehearsal system for information that is received aurally (Baddeley & Larsen, 2007). It is assumed that rehearsal is necessary for retaining information until it can be transferred into long-term memory. For example, at the annual Academy of Human Resource Development (AHRD) Conference, it is announced that there is a reception in the “Starbright Ballroom.” Many attendees likely repeat “Starbright Ballroom” or just “Starbright” in their heads until it is committed to memory or has moved from working memory to long-term memory. Assume that before one of the attendees can commit “Starbright” to memory, they are introduced to a guest speaker. Now that the attendee is paying attention to the introduction, “Starbright” will be replaced by the guest speaker’s name in the attendee’s working memory. The location of the reception has likely been lost.

The visuospatial sketchpad is believed to be capable of temporarily storing and manipulating visual and spatial information. It allows a range of sources of visual information, including motor, physical, touch, smell, and taste. This information must be
subvocalized to register it in the audio store to be available for rehearsal. For example, at
the AHRD Conference, an attendee sees a break-out session they would like to attend.
The attendee wants to introduce themselves to the presenter. The attendee will
subvocalize the name in their head to be rehearsed and committed to memory. Since
visual-spatial information has to be converted, Baddeley hypothesized that it takes more
energy to process visual information than audio information.

Baddeley’s hypothesis underpins the modality effect. According to the modality
effect, when the learning material is presented visually through an illustration, and the
related text is presented aurally, the visual information remains in the visual store for
processing. The aurally received text is automatically stored in the rehearsal loop. This
allows for more significant learning because the working memory is not overworked, and
information can move into long-term memory. When learning material is presented
visually-only, the data must be converted to the phonological store, and the system can
become overloaded.

As discussed earlier, many studies have endorsed a reverse modality effect. It is
hypothesized that self-paced learning and complex learning material contribute to the
reverse modality effect (Crooks et al., 2012; Tabbers et al., 2004). The current study did
not incorporate these factors. For these reasons, it was hypothesized that:

*Hypothesis 1:* Virtual workers who receive training material in an audio-visual
format will have better working memory recall than virtual workers who receive
material in a visual-only format as measured by a posttest assessment of
Microsoft Teams functionality knowledge.
Considering that scholars estimate information is either lost or enters long-term memory in two to 30 seconds, the working memory assessment in the current study could theoretically be assessing working memory or long-term memory. This study assumed that the further removed from the intervention, evidence of long-term memory recall becomes more reliable. For this reason, long-term memory recall was assessed one-week post-intervention. Segers et al. (2008) and Witteman and Segers (2010) have established a link between long-term recall and the modality effect. These studies guided the current research as they found significant evidence of the modality effect one-week post-intervention. For this reason, and those stated in Hypothesis 1, it was hypothesized that:

**Hypothesis 2:** Virtual workers who receive training material in an audio-visual format will have better long-term memory recall than virtual workers who receive material in a visual-only format as measured by a one-week posttest assessment of Microsoft Teams functionality knowledge.

**Chapter Summary**

In this chapter, instructional technology was briefly reviewed with the relevant studies of the past year. Then, memory was discussed. Baddeley’s working memory model components were defined, working and long-term memory were explained, and opposing memory models were identified. Next, the modality effect was detailed. Modality effect studies of working and long-term memory were reviewed, as was the reverse modality effect. Lastly, support for the research hypotheses was provided.
Chapter 3 – Methodology

Introduction

Chapter 3 describes the methods and design of the study. The chapter begins with the purpose of the study and research hypotheses. Next, the population, sample frame, sample, and sample representativeness are detailed. Then, the research design provides an in-depth recount of the material, stimuli, and measures. Afterward, the survey design is comprehensively explained, followed by a summary of the pilot study. Ultimately, the data collection procedures, data analysis procedures (data cleaning, descriptive statistics, statistical assumptions, and hypotheses testing), internal and external validity, and limitations are discussed. The chapter concludes with a summary.

Purpose of the Study

The purpose of this study was to evaluate the modality effect by examining the effect that learning content presented in a visual-only format compared to an audio-visual form has on working and long-term memory recall in the context of a virtual workplace tool training module presented to virtual employees. As suggested by Baddeley and Hitch (1974), working memory was assessed immediately after the intervention. As indicated by Segers et al. (2008) and Witteman and Segers (2010), long-term memory was evaluated one week after the intervention. The framework for evaluation of the causal inference was underpinned by the Campbellian approach (Alferes, 2012). The Campbellian approach, from the reductionism system thinking, is acclaimed as the most accepted internal validity framework (Chen, 2016; Julnes, 2011). The Campbellian approach assumes parsimony in the evaluation of causal relationships (Chen, 2016). In accordance, the Campbellian classification is organized around two characteristics: the
manipulation of independent variables and the use of randomization methods (Alferes, 2012). As highlighted in Table 5, this study was classified as a completely randomized between-subjects experimental design. After the prescreening survey identified the sample, an experiment was performed using two randomly assigned groups, treatment, and control.

Table 5

*Static-Group Comparison*

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Intervention</th>
<th>Time 1</th>
<th>Time 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>AV</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>R</td>
<td>V</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

*Note.* Posttest-only control group design.  
R = randomly assigned American virtual worker  
AV = Audio-visual stimuli  
V = Visual-only stimuli  
Time 1 = immediate posttest data collection  
Time 2 = one-week posttest data collection

**Research Hypotheses**

Baddeley’s working memory model (2000) and the separate streams hypothesis of the modality effect provide a theoretical basis for the research hypotheses.

*Hypothesis 1:* Virtual workers who receive material in an audio-visual format will have better working memory recall than virtual workers who receive material in a visual-only format as measured by a posttest assessment of Microsoft Teams functionality knowledge.

Based on the separate streams hypothesis, audio-visual information does not overload the cognitive system, allowing more information to enter long-term memory. For this reason and those stated above, it was hypothesized:
Hypothesis 2: Virtual workers who receive material in an audio-visual format will have better long-term memory recall than virtual workers who receive material in a visual-only format as measured by a one-week posttest assessment of Microsoft Teams functionality knowledge.

Population

The population met the following criteria: (a) employed; (b) virtual workers including temporary virtual workers due to the COVID-19 pandemic; (c) had no experience with Microsoft Teams; (d) resided in the U.S.; (e) self-reported no memory issues due to a traumatic brain injury, concussion, or stroke; (f) self-reported no memory diseases such as Alzheimer’s and dementia; (g) self-report no reading disorders; (h) self-reported no attention deficiencies; and (g) self-reported not autistic. A critical factor in testing causal relationships is to ensure that the collected sample data is representative of the population and that the control and treatment groups are equal. Additional demographic information regarding the population was collected (i.e., gender, age, race, education, and occupation). Professional occupation was defined as management, professional, and related occupations (management; business and financial operations; computer and mathematical; architecture; engineering; life, physical, and social science; community and social service; legal; education, training, and library; arts, design, entertainment, sports, and media; healthcare practitioners and technical; sales and related; office and administrative support (BLS, 2020a).

Sample Frame

The sampling process used in this study did not allow every member of the intended population to have the chance to participate in the experiment. Fowler (2014)
expressed, “how well a sample represents a population depends on the sample frame, sample size, and the specific design of the selection procedures” (p. 14). Fowler described the sample frame as consisting of individuals who have a possibility to be included in the study. The sample frame for this study consisted of U.S. based MTurk® workers.

Many scholars argued against the use of MTurk® for data collection citing misrepresentation (Sharpe, Huber, & Netzer, 2017), inadequate response validity (Chmielewski & Kucker, 2020), questionable participant behaviors (Necka, Cacioppo, Norman, & Cacioppo, 2016), and lack of effort when answering survey questions (Hauser, Paolacci, & Chandler, 2018). The U.S. MTurk® population does not generalize to the U.S. worker population. The MTurk® population was considerably younger with 47% of MTurkers under the age of 30 compared to 34% of the U.S. working population. MTurkers were predominately Caucasian with 77% of the MTurk population compared to 67% of U.S. workers. MTurkers were more educated than the U.S. working class with 87% reporting a college education compared to 67% (see Table 6). However, for the following six reasons, MTurk® was used as the sample frame, and the steps that were taken to generalize the sample to the population were discussed in the Data Collection section (Lemm, 2010). First, in a meta-analysis that reviewed 35 journal articles, Mortensen and Hughes (2018) stated, “the literature overwhelmingly concludes that MTurk® is an efficient, reliable, cost-effective tool for generating sample responses that are largely comparable to those collected via more conventional means” (p. 533). Second, researchers reported MTurk® as a reliable source when conducting repeated measures studies with response rates after two months ranging from 64% to 86% (Daly &
Natraajan, 2015; Strickland & Stoops, 2018). Third, in recent years, researchers became increasingly interested in moving experimental studies out of the traditional laboratory onto the popular crowdsourcing platform (cf. Wang, Huang, Yao, & Chan, 2015; Yen, Chu, Yeh, Chu, & Huang, 2013). Fourth, Horton, Rand, and Zeckhauser (2011) found evidence that MTurk® workers behave similarly to subjects in physical laboratories. Fifth, a review of the recent literature shows that studies similar to this experimental design completed successful experimentation using the MTurk® platform (cf. Amit, Wakslak, & Trope, 2013; Flusberg, Lauria, & Thibodeau, 2018; Kim & Park, 2017; Yuan & Besley, 2017). Lastly, Horton et al. (2011) suggested that MTurk® workers have an attractive quality of not being experiment-savvy.
Table 6

*Population and Sample Frame Demographics*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Population</th>
<th>MTurk®</th>
<th>$\chi^2$</th>
<th>df</th>
<th>$p$-value</th>
<th>Cramèr’s $V$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>52%</td>
<td>49%</td>
<td>12.102</td>
<td>1</td>
<td>&lt; 0.01</td>
<td>0.06</td>
</tr>
<tr>
<td>Women</td>
<td>48%</td>
<td>51%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 - 29</td>
<td>34%</td>
<td>47%</td>
<td>223.82</td>
<td>1</td>
<td>&lt; 0.01</td>
<td>0.27</td>
</tr>
<tr>
<td>30 - 49</td>
<td>66%</td>
<td>53%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>67%</td>
<td>77%</td>
<td>152.26</td>
<td>1</td>
<td>&lt; 0.01</td>
<td>0.21</td>
</tr>
<tr>
<td>Other</td>
<td>33%</td>
<td>23%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School or less</td>
<td>33%</td>
<td>13%</td>
<td>87.15</td>
<td>1</td>
<td>&lt; 0.01</td>
<td>0.43</td>
</tr>
<tr>
<td>College education</td>
<td>67%</td>
<td>87%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional</td>
<td>62%</td>
<td>68%</td>
<td>21.88</td>
<td>1</td>
<td>&lt; 0.01</td>
<td>0.12</td>
</tr>
<tr>
<td>Other</td>
<td>38%</td>
<td>32%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


**Sample**

A two-sample $t$ test power analysis indicated that to achieve $p < 0.05$ and $d > 0.50$, the sample size would need to be 140 (see Appendix C). The desired sample consisted of 140 employed MTurk® virtual workers in the U.S. who did not have experience with Microsoft Teams, reported no injuries or medical conditions that impede memory, no attention, and no reading disorders. Data from a pilot study suggested that approximately 39% of prescreening respondents would qualify for the experiment, 93% would respond to T1, and 72% would respond to the T2 surveys (see Appendix D).
Based on these findings, it was estimated that 537 surveys would need to be collected in the prescreening, 210 at T1, and 195 at T2 (see Table 7).

Table 7

Needed to Collect 140 Usable Responses

<table>
<thead>
<tr>
<th>Calculation for</th>
<th>Responses Needed</th>
<th>Paid to MTurker</th>
<th>MTurk® fees</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responses Needed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39% will qualify</td>
<td>537</td>
<td>$0.25</td>
<td>$53.70</td>
<td>$187.95</td>
</tr>
<tr>
<td>93% @ T1</td>
<td>210</td>
<td>$0.60</td>
<td>$50.40</td>
<td>$176.40</td>
</tr>
<tr>
<td>72% @ T2</td>
<td>195</td>
<td>$0.50</td>
<td>$39.00</td>
<td>$136.50</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>$500.85</td>
</tr>
</tbody>
</table>

Note. *The MTurk® fee is 40%.*

Materials, Stimuli, and Measurement

There were four main procedures in preparation for the experiment to test the research hypotheses. First, the material was identified. In an experimental design, the materials are the items used in the intervention (Moreno & Mayer, 1999). In this study, the material was the Microsoft Teams (2020) lesson, “Quick Start Guide,” developed by Microsoft. Second, the intervention stimuli were identified. Stimuli are the elements used in an experimental design to elicit a reaction from the participant (Tamthinthai & Sahachaisaeree, 2012). The stimuli for this study were the audio-visual and visual-only presentations. Third, assessments to test the working memory and long-term memory recall were produced. Fourth, the assessments were endorsed for content validity. These four procedures are detailed in the following section.
Materials

When the spread of COVID-19 hit the pandemic level, city and county governments began implementing mandatory nonessential business closures. Companies that did not have an infrastructure to manage a virtual workplace had to quickly identify a product that could keep employees connected and keep business as routine as possible. With in-person meetings no longer an option, companies turned to free programs offered by Adobe, Cisco, Dropbox, Facebook, Google, IBM, Microsoft, and Zoom (Giles, 2020; Molla, 2020). However, employees had to be trained in these programs. To test the research hypotheses, this study used an audio-visual and a visual-only lesson of the basics of Microsoft Teams. This lesson was selected for three reasons. First, Microsoft Teams is a software platform for team collaboration, making it a timely subject matter. Second, Microsoft Teams is a part of the Office 365 package, the most commonly used operating system (Chand, 2019). Third, Microsoft has readily available lessons overviewing Microsoft Teams in audio-visual and visual-only formats.

Stimuli

To evaluate the modality effect, the material was presented to the treatment group in an audio-visual format. The modality effect indicates that the audio-visual format consists of visual material such as figures, graphs, or illustrations accompanied by a verbal explanation. The treatment group stimuli was a video presentation https://youtu.be/jugBQqE_2sM of the Microsoft Teams lesson that verbally walked the learner through the program using screenshots (pictures). The control group received a visual-only presentation of the same material. The visual-only lesson has screenshots accompanied by text (see Appendix E). The training material was developed by
Measurement

To test the research hypotheses, 10 multiple-choice questions were created to assess the modality effect. The multiple-choice question type leads to greater survey completion rates (Arimond & Elfessi, 2001; Dolničar & Leisch, 2001). Each question had four answer choices, with only one option being the correct answer. This is the most familiar of the multiple-choice question types (Kramer, 2018). The literature suggested that the multiple-choice question type is an accepted test in reading recall research (Chung-Fat-Yim, Peterson, & Mar, 2016; Moys, Loveland, & Dyson, 2018; Ramalingam, Naidu, Hariish, & Naidoo, 2018). As such, the same 10 questions were used in both of the memory recall tests. Studies found that the order of multiple-choice questions does not affect test performance (Laffitte, 1984; Neely, Springston, & McCann, 1994; Periini, Lind, & Mumbo, 1998; Peters & Messier, 1970; Pettijohn & Sacco, 2007). However, it was recommended that the questions were presented in random order in the Time 2 survey (Butler, Karpicke, & Roediger, 2007; Cantor, Eslick, Marsh, Bjork, & Bjork, 2015). Pearson’s (2020) TestGen test generator was used to scramble the questions and answer choices for the long-term working memory recall (T2). The development of the measurement involved three phases, (1) creation of questions and answer choices, (2) content validity, and (3) pilot study. Nunnally (1978) recommended testing one and a half times the number of items desired for the measurement instrument to allow for items that perform poorly to be eliminated. Careful consideration was given to creating 30 multiple-choice questions with four answer choices. Options were homogenous in
content, plausible, similar in length, short as possible, and negatively worded questions were avoided (Coughlin & Featherstone, 2017; Smith, 2019). The TestGen program shuffled the questions and answer choices so that they were randomly assigned and ordered.

**Content validity.** The 30 questions were evaluated for face validity by a panel of individuals with a rich knowledge of Microsoft Teams (Gaber, 2010; Sireci, 2007). The group consisted of five professionals who use Microsoft Teams daily to manage their employees (see Appendix F for biographies). The panel was instructed through email to do the following: (1) review the lesson material, (2) take the assessment, and (3) critically judge the questions and identify any that may be unclear, vague, or unrelated to Microsoft Teams (Pett, Lackey, & Sullivan, 2003). Minor edits were suggested to reduce the redundancy of how questions were worded. Then, the panel unanimously judged the instrument as a reasonable assessment of Microsoft Team’s “Quick Start Guide.”

**Pilot Study.** A pilot study was conducted to assess the measurement instruments and inform the main study (see Appendix D). The pilot study was considered a trial run to identify any potential problems and processes to correct them before launching the experiment on a large scale. The purpose of the pilot study was two-fold. First, to test the ability of the measurement items to assess memory recall. Second, to assess the feasibility of the experimental methods using MTurk® to collect data to test the research hypotheses. There is no universal consensus on the sample size of the pilot study (Cocks & Torgerson, 2013; Julious, 2005; Kim, 2017). To collect enough data to inform the main study, the pilot study’s desired sample size was 60. First, 311 prescreening surveys were collected and cleaned. From those, 107 participants qualified to participate in the
intervention. Groups were randomly assigned, using the R package randomizR. The treatment group (audio-visual presentation), consisted of 53 members, and the control group (visual-only presentation), consisted of 54 members. The sample was invited to participate in the intervention by email using pyMTurkR. Ninety-nine participants completed the intervention and were invited to participate in the follow-up survey. Of those, 56 responded to the follow-up survey. The subjects of the pilot study were not eligible to participate in the main study.

The data were evaluated to identify 10 questions that best measured memory recall of the Microsoft Teams lesson. First, descriptive statistics were generated for each test item to assess statistical significance, practical significance, the symmetry of the data, and peakedness of the data. Then, as suggested by Ames (2018), each item was assessed for item difficulty, item discrimination, item variance, and item reliability (see Table 8).

**Descriptive statistics.** Statistical significance was calculated using the T. DIST function in Excel. The statistical significance of the t test was determined at $p \leq 0.05$ (Fisher, 1925). To assess the effect size, Cohen’s $d$ was computed as $d = \frac{(M_t - M_c)}{SD_{pooled}}$, where $M_t$ is the mean of the treatment group, and $M_c$ is the mean of the control group. Practical significance was determined at $d \geq 0.39$ (Cohen, 1988). The symmetry of the data were evaluated by the skewness. Skewness was calculated using R® and determined acceptable in the range of +3 to -3 (Taylor, 2008). All of the data collected fell within the acceptable range for skewness. Lastly, the distribution of the data were analyzed by kurtosis and computed using R®. Normal distribution was determined by kurtosis between 0 to -2 (Cameron, 2004; Richardson, 2018; Taylor, 2008). Six items failed to meet the criteria for normal distribution (i.e., questions 1, 14, 19, 22, 23, and 28).
**Item difficulty.** Item difficulty was assessed to identify items that unable to differentiate between low and high-level responses. Item difficulty was assessed by calculating $p$ value, $p_{\text{value}_i} = \frac{N_{\text{correct}_i}}{N}$, where $N_{\text{correct}_i}$ was the number of correct answers; $N$ = total number of responses (Ames, 2018). Ames (2018) suggested removing items that are too easy ($p_{\text{value}_i} < 0.02$) and items that are too difficult ($p_{\text{value}_i} > 0.95$). Following this guideline, no items were eliminated for item difficulty.

**Item discrimination.** Item discrimination was evaluated by item-total correlation (ITC). Item discrimination informs how likely respondents are to answer correctly or incorrectly using the formula. $\text{ITC}_i = \frac{M_{\text{correct}_i} - M_{\text{total}_i}}{\text{score variance}} \times \frac{p_{\text{value}_i}}{1 - p_{\text{value}_i}}$, where $M_{\text{correct}_i} = $ the average assessment score for those who answered correctly; $M_{\text{total}_i} = $ the average assessment score for all responses; score variance = the summed score variance for all responses. Ames (2018) advised removing items that have a negative or near zero ITC. No items were eliminated based on ITC.

**Item variance.** Item variance was calculated to evaluate the distance an item’s score deviated from the mean score. $\text{Item variance}_i = (p_{\text{value}_i}) \times (1 - p_{\text{value}_i})$. The smaller the item variance, the more likely respondents are to answer alike. Items with higher variance provide greater measurement reliability (Ames, 2018).

**Item reliability.** Lastly, item reliability was calculated by $\text{Item reliability}_i = \sqrt{(\text{item variance}_i \times \text{ITC}_i)}$. The larger the item reliability value, the greater the overall measurement reliability (Ames, 2018).
Table 8

*Descriptive and Analytical Statistics for Measurement Evaluation (n = 99)*

<table>
<thead>
<tr>
<th>Question and answer choices Item</th>
<th>Treatment Group</th>
<th>Control Group</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$ ($SD$)</td>
<td>Skew</td>
<td>$\beta_2$</td>
</tr>
<tr>
<td>1. For a view that lets you catch up on all your unread messages, @mentions, replies, and more, choose__. tabs; activity; teams; calendar</td>
<td>0.88 (0.33)</td>
<td>-2.30</td>
<td>3.40</td>
</tr>
<tr>
<td>2. To stay in sync with your team, __. sync calendar with outlook; allow text notifications; set-up email notifications; download the mobile app*</td>
<td>0.47 (0.50)</td>
<td>0.11</td>
<td>-2.00</td>
</tr>
<tr>
<td>3. To talk privately with a person or a group, click __. chat icon; someone’s profile picture; @mention someone; envelope icon</td>
<td>0.29 (0.46)</td>
<td>0.88</td>
<td>-1.30</td>
</tr>
<tr>
<td>4. To see all team conversations and every file, select the team__. channel; name; files; activity</td>
<td>0.49 (0.50)</td>
<td>0.04</td>
<td>-2.00</td>
</tr>
<tr>
<td>5. To see everything you have lined-up for the day or week, go to__. activity; tabs; side menu; meetings</td>
<td>0.73 (0.45)</td>
<td>-0.98</td>
<td>-1.10</td>
</tr>
</tbody>
</table>
Table 8 (Continued)

*Descriptive and Analytical Statistics for Measurement Evaluation (n = 99)*

<table>
<thead>
<tr>
<th>Question and answer choices</th>
<th>Control Group</th>
<th>Treatment Group</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>ITC</td>
</tr>
<tr>
<td></td>
<td>Skew β² t p</td>
<td>Skew β² t p</td>
<td>Var</td>
</tr>
<tr>
<td><strong>6. Use __ to search for specific items or people, take quick actions, and launch apps. tabs; files; command box; channels</strong></td>
<td>0.47 (0.50)</td>
<td>0.35 (0.48)</td>
<td>0.18 0.20 0.41 20.20 0.71 3.80</td>
</tr>
<tr>
<td><strong>7. Teams are made-up of files; conversations; channels; users</strong></td>
<td>0.65 (0.48)</td>
<td>0.73 (0.45)</td>
<td>0.28 0.017 0.69 33.83 2.19 8.61</td>
</tr>
<tr>
<td><strong>8. At the top of each channel, you'll find they are like links to your favorite files, apps, and services. tabs; channels; activity; favorites</strong></td>
<td>0.63 (0.49)</td>
<td>0.31 (0.47)</td>
<td>0.67 0.47 23.38 0.90 4.60</td>
</tr>
<tr>
<td><strong>9. ____ is where to hold meetings, have team conversations, and share files. tabs; files; channels; dashboard</strong></td>
<td>0.73 (0.45)</td>
<td>0.65 (0.48)</td>
<td>0.69 33.83 2.19 8.61</td>
</tr>
</tbody>
</table>
Table 8 (Continued)

*Descriptive and Analytical Statistics for Measurement Evaluation (n = 99)*

<table>
<thead>
<tr>
<th>Question and answer choices</th>
<th>Treatment Group</th>
<th>Control Group</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>Skew</td>
<td>β²</td>
</tr>
<tr>
<td>10. Where can you see a list of all of the teams you are a part of? on the top menu, on the left side menu, channels, tabs</td>
<td>0.57 (0.50)</td>
<td>-0.27</td>
<td>-2.00</td>
</tr>
<tr>
<td>11. You and your team can edit a document at the same time when the file is in files; in OneDrive; in SharePoint; in the channel conversation*</td>
<td>0.39 (0.49)</td>
<td>0.43</td>
<td>-1.90</td>
</tr>
<tr>
<td>12. __ is where the real work gets done. Meetings; files; channels; tabs*</td>
<td>0.22 (0.42)</td>
<td>1.13</td>
<td>-0.02</td>
</tr>
<tr>
<td>13. To make a chat easy to find later, __ save it to files; tag it; move it to favorites; give it a name*</td>
<td>0.37 (0.49)</td>
<td>0.51</td>
<td>-1.80</td>
</tr>
</tbody>
</table>
Table 8 (Continued)

Descriptive and Analytical Statistics for Measurement Evaluation (n = 99)

<table>
<thead>
<tr>
<th>Question and answer choices</th>
<th>Control Group</th>
<th>Treatment Group</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>Skew</td>
<td>β²</td>
</tr>
<tr>
<td>14. In chat, click on the video button to make a video call; record message; send an emoji; save a screen shot.</td>
<td>0.88 (0.33)</td>
<td>-2.30</td>
<td>3.40</td>
</tr>
<tr>
<td>15. You can schedule a meeting in calendar or activity: meetings; tab; chat</td>
<td>0.75 (0.44)</td>
<td>-1.10</td>
<td>-0.82</td>
</tr>
<tr>
<td>16. To find a list of all the teams you are a part of, select Channels</td>
<td>0.73 (0.45)</td>
<td>-0.98</td>
<td>-1.10</td>
</tr>
<tr>
<td>17. When you share a file in a channel conversation, you and your team can edit it one at a time; share thoughts alongside it; read-only; make anonymous suggestions*</td>
<td>0.73 (0.45)</td>
<td>-0.98</td>
<td>-1.10</td>
</tr>
</tbody>
</table>
Table 8 (Continued)

*Descriptive and Analytical Statistics for Measurement Evaluation (n = 99)*

<table>
<thead>
<tr>
<th>Question and answer choices</th>
<th>Control Group</th>
<th>Treatment Group</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>Skew</td>
<td>β²</td>
</tr>
<tr>
<td>18. To quickly search for people, use the address book; calls icon; <strong>command box</strong>; chat icon</td>
<td>0.33 (0.48)</td>
<td>0.69</td>
<td>-1.60</td>
</tr>
<tr>
<td>19. To make an audio call from a chat, select <strong>telephone icon</strong>; person’s profile picture; calls on the left menu; meet now</td>
<td>0.76 (0.43)</td>
<td>-1.20</td>
<td>-0.54</td>
</tr>
<tr>
<td>20. To help your team stay organized and have conversations, all in one place, download <strong>channels</strong>; Microsoft mobile app; <strong>teams</strong>; OneDrive*</td>
<td>0.51 (0.50)</td>
<td>-0.04</td>
<td>-2.00</td>
</tr>
<tr>
<td>21. To see a feed of everything that has happened lately, select <strong>tabs</strong>; <strong>activity</strong>; teams; calendar</td>
<td>0.31 (0.47)</td>
<td>0.78</td>
<td>-1.40</td>
</tr>
</tbody>
</table>
Table 8 (Continued)

Descriptive and Analytical Statistics for Measurement Evaluation (n = 99)

<table>
<thead>
<tr>
<th>Question and answer choices</th>
<th>Treatment Group</th>
<th>Control Group</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$ (SD)</td>
<td>Skew</td>
<td>$\beta$</td>
</tr>
<tr>
<td>22. The mobile app can be downloaded from menu; apps; tabs; <strong>profile</strong></td>
<td>0.92 (0.27)</td>
<td>-3.00</td>
<td>7.40</td>
</tr>
<tr>
<td>23. To start a private conversation select <strong>new chat</strong>; select their profile picture; mention someone; envelope icon</td>
<td>0.06 (0.24)</td>
<td>3.60</td>
<td>11.00</td>
</tr>
<tr>
<td>24. To see all the files shared across a channel, in the files menu, select <strong>documents</strong>; OneDrive; SharePoint; <strong>files</strong>*</td>
<td>0.86 (0.35)</td>
<td>-2.00</td>
<td>2.20</td>
</tr>
<tr>
<td>25. To see all team conversations and every file, select the team <strong>channel</strong>; app; tab; activity</td>
<td>0.63 (0.49)</td>
<td>-0.51</td>
<td>-1.80</td>
</tr>
<tr>
<td>26. To make an audio call from a chat, select <strong>telephone icon</strong>; person’s profile picture; dial number; call contact</td>
<td>0.39 (0.49)</td>
<td>0.43</td>
<td>-1.90</td>
</tr>
</tbody>
</table>
Table 8 (Continued)

*Descriptive and Analytical Statistics for Measurement Evaluation (n = 99)*

<table>
<thead>
<tr>
<th>Question and answer choices</th>
<th>Treatment Group</th>
<th>Control Group</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>p</td>
</tr>
<tr>
<td></td>
<td>Skew β²</td>
<td>Skew β²</td>
<td>t</td>
</tr>
<tr>
<td>27. To start a meeting</td>
<td>0.80 (0.40)</td>
<td>0.67 (0.48)</td>
<td>-1.60</td>
</tr>
<tr>
<td>select video call;</td>
<td>-1.50</td>
<td>-0.69</td>
<td>1.30</td>
</tr>
<tr>
<td>meet now; join</td>
<td>0.21</td>
<td>0.21</td>
<td>0.55</td>
</tr>
<tr>
<td>meeting; start a new</td>
<td>1.55</td>
<td>1.55</td>
<td>0.13</td>
</tr>
<tr>
<td>meeting*</td>
<td>-1.10</td>
<td>-0.69</td>
<td>-1.60</td>
</tr>
<tr>
<td>28. Tabs are used</td>
<td>0.18 (0.39)</td>
<td>0.15 (0.36)</td>
<td>1.90</td>
</tr>
<tr>
<td>to organize files;</td>
<td>1.60</td>
<td>1.90</td>
<td>0.37</td>
</tr>
<tr>
<td>move between teams;</td>
<td>0.73</td>
<td>1.80</td>
<td>0.37</td>
</tr>
<tr>
<td>link apps and services</td>
<td>0.15 (0.36)</td>
<td>1.90</td>
<td>0.41</td>
</tr>
<tr>
<td>29. To search for stuff</td>
<td>0.27 (0.45)</td>
<td>0.38 (0.49)</td>
<td>-1.80</td>
</tr>
<tr>
<td>in Microsoft Teams,</td>
<td>0.98</td>
<td>0.98</td>
<td>-1.80</td>
</tr>
<tr>
<td>use the activity</td>
<td>-1.10</td>
<td>-1.10</td>
<td>-1.06</td>
</tr>
<tr>
<td>feed; search tab;</td>
<td>0.30 (0.49)</td>
<td>0.50</td>
<td>-1.06</td>
</tr>
<tr>
<td>command box;</td>
<td>0.27 (0.45)</td>
<td>0.50</td>
<td>-1.80</td>
</tr>
<tr>
<td>search field</td>
<td></td>
<td>-1.06</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>30. Teams are made-up of</td>
<td>0.27 (0.45)</td>
<td>0.58 (0.50)</td>
<td>-0.33</td>
</tr>
<tr>
<td>files; apps; channels;</td>
<td>0.98</td>
<td>0.98</td>
<td>-0.33</td>
</tr>
<tr>
<td>tabs*</td>
<td>0.98</td>
<td>0.98</td>
<td>-3.23</td>
</tr>
<tr>
<td></td>
<td>0.58</td>
<td>0.58</td>
<td>-3.23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0.33</td>
<td>-3.23</td>
</tr>
<tr>
<td></td>
<td>0.27</td>
<td>0.27</td>
<td>0.65</td>
</tr>
<tr>
<td></td>
<td>(0.45)</td>
<td>(0.45)</td>
<td>0.65</td>
</tr>
</tbody>
</table>

*Note.* β² = kurtosis; ITC = item-total correlation; Var. = item variance; Rel = item reliability; * indicates item that was retained.
**Item selection.** First, the questions were reviewed for statistical and practical significance to determine the items that would be retained for the assessment. Items 2, 8, 11, 12, 13, 17, 20, 24, and 30 were retained because there were statistically and practically significant; \( p \leq 0.05 \) and \( d \geq 0.39 \). Then, item variance and reliability were evaluated for the remaining 15 items. Considering that items with higher variance provide greater measurement reliability and the larger the item reliability value, the greater the overall measurement reliability, question 27 was retained as the 10th item (Ames, 2018).

The final assessment, Microsoft Teams Working Memory Test, is presented in Appendix G. The 10 questions were entered into Pearson Test Gen, and the items and options were shuffled to create the Microsoft Teams Long-Term Test (see Appendix H).

**Survey Design**

Five surveys were created to test the research hypotheses: (1) prescreening survey, (2) working memory recall survey for the treatment group, (3) working memory recall survey for the control group, (4) long-term memory recall survey for the treatment group, and (5) long-term memory recall survey for the control group. The working memory and long-term memory recall survey questions were the same for both groups. However, a survey was created for each group to better facilitate data collection. All surveys were generated using Qualtrics\textsuperscript{xm}, an online task platform, to collect data for inclusion criteria and experimental data. Surveys in Qualtrics\textsuperscript{xm} are created in **blocks**. Each block was displayed as a new screen when completing the survey. Blocks can contain descriptive text, video, graphics, or questions of various formats.
Each of the surveys began with a Captcha Verification. Qualtrics\textsuperscript{\textregistered} (2019) recommended using a Captcha Verification (Completely Automated Public Turing Test to tell Computers and Humans Apart) to ensure that the sample consists of human beings and not robots. A Captcha is a challenge with pictures or words. The participant must correctly respond to the challenge to proceed with the Task. Qualtrics\textsuperscript{\textregistered} claimed that Captcha tasks are easy for humans, but spam programs find the tasks nearly impossible. Creating a Captcha is easy using Qualtrics\textsuperscript{\textregistered} by clicking the “Create New Question” tab and selecting “Captcha Verification” from the “Advanced” menu.

To prevent missing data, forced responses, a feature of Qualtrics\textsuperscript{\textregistered}, was enabled for each question (Barakji, 2017). Qualtrics\textsuperscript{\textregistered} defaults to not allowing participants to use the back button. Since participants were encouraged to answer the questions from memory, the back button was not available. The prevent ballot-box stuffing option was selected in Qualtrics\textsuperscript{\textregistered} to prevent participants from taking the survey more than once. However, Qualtrics\textsuperscript{\textregistered} (2019) warned that savvy users could circumvent this option by clearing their browser cookies or switching to a different web browser. This was not a concern for this study since only those with the proper qualification could access the task.

In a study of 25,080 surveys, Liu and Wronski (2018) reported that those without progress bars had a higher completion rate; thus, none of the five surveys in this study had progress bars. Fan and Yan (2010) reported that surveys sponsored by academic institutions have a higher response rate; as such, the University of Texas at Tyler logo was visible at the top of each screen. It was essential to the study that participants answer the questions from memory. To reduce the temptation to look-up answers, the time allowed for the exam was limited (Daneman & Hannon, 2001; Tookoian, 2016;
Westerkamp, Heijne-Penninga, Kuks, & Cohen-Schotanus, 2013). Researchers showed that when the test taker is prepared for the exam, it takes between 30 to 36 seconds to answer a short multiple-choice question (Nelson, 2016; Pettijohn & Sacco, 2007; Schneid et al., 2014). As such, participants in the current study had 30 seconds per question, which allowed them five minutes to complete the 10 question assessment.

The goal of the researcher was to conduct this research ethically with respect to the participants. In compliance with The University of Texas at Tyler, participants were asked to consent to their voluntary participation in each of the surveys. The consent form's purpose was to provide information that any reasonable person would want to know before volunteering for the study (Sieber, 2004). To increase personal data disclosure and promote survey response, participants were guaranteed anonymity and assured that there were no repercussions for not participating or completing their involvement in the study (Murdoch et al., 2014). Marks and Yardley (2004) suggested that people will not want to respond if they feel they are being judged. To reduce anxiety, survey takers were encouraged to do their best on the survey and were informed that there were no consequences of right or wrong answers.

After completing the survey, the MTurker received a unique code on the final screen that was copied into MTurk® as a confirmation code to trigger payment. Participants who do not pass the Captcha or did not consent were advanced to a screen that read, "We require that participants provide their consent and pay attention to the questions being asked. You have provided an unacceptable response and will not be asked to complete the HIT. Thank you for your time."
**Prescreening Survey**

A prescreening survey was used to ensure that the sample was representative of the population and promote equal groups (see Appendix I). The prescreening survey was expected to take two minutes to answer eight prescreening and five demographic questions. The first block contained a Captcha, which had to be successfully answered before proceeding with the survey. The second block featured the consent to the survey, which had to be accepted before the participant could move to the next screen. The third block contained the following eight questions:

1. **My employment status is:**
   - a. Unemployed
   - b. Employed full-time
   - c. Employed part-time

2. **Select the option that best describes your work location:**
   - a. I currently work at my employer’s location
   - b. I currently work from home due to the COVID-19 pandemic
   - c. I am a virtual employee

3. **Do you now, or have you ever used the computer program Microsoft Teams?**

4. **Have you experienced a traumatic brain injury, concussion, or stroke that resulted in permanent memory impairment?**

5. **Do you suffer from Alzheimer's Disease, dementia, Korsakoff syndrome, or Parkinson's disease?**

6. **Do you self-identify with attention deficit disorder (ADD) or attention deficit hyperactivity disorder (ADHD)?**
7. Do you self-identify as autistic?

8. Do you struggle with reading due to dyslexia, dysgraphia, or a reading disorder?

The fourth block contained the following five multiple-choice demographic questions.

1. Please select the option that you best identify with (Male, Female).

2. Please select the option that represents your age (18-34, 35-54, 55+).

3. Please select the option that most closely resembles your race/ethnicity (Asian, Black, Hispanic, White, other).

4. Please select the option that most closely represents your educational attainment.
   (Did not graduate high school; high school or equivalent; some college, but no degree; Associate’s degree; Bachelor’s degree; Graduate degree)

5. Which of the following best describes your occupation? (management, professional, and related occupations (management; business and financial operations; computer and mathematical; architecture; engineering; life, physical, and social science; community and social service; legal; education, training, and library; arts, design, entertainment, sports, and media; healthcare practitioners and technical; sales and related; office and administrative support), service occupations (healthcare support; protective service; food preparation and serving related; building maintenance and grounds cleaning; personal care and service), natural resources, construction, and maintenance (farming, fishing, and forestry; construction and extraction; installation, maintenance, and repair), production, transportation, and material moving occupations
The fifth block displayed a message that read, “Your response has been recorded. Thank you for your time and participation. Please copy and paste the following code into the MTurk® HIT to receive payment”

**Intervention and Working Memory Recall**

To administer the intervention and collect data to test the modality effect in working memory recall, two surveys, one for the treatment group (see Appendix J) and one for the control group (see Appendix K), was created using Qualtrics™. Both surveys began with a Captcha in the first block and the consent form in the second block. The third block of both surveys displayed the intervention. The fourth block began with instructions that read, “Your responses are very important to this research. You have five minutes to answer 10 questions. Please, read every question and answer to the best of your ability from memory, without looking up the answers. You will not be penalized for wrong answers, and your survey is anonymous.” The surveys concluded with the following message:

Bonuses opportunity! We will be sending you a personal invitation to participate in our follow-up survey. Expect an email from Gaby Lambert in one week. Thank you for your time. Please copy and paste the following code into the MTurk® HIT to receive payment.

Embedded data was set in Qualtrics™, with a code placed in the HITS (Human Intelligence Task) page on MTurk® to capture the MTurk® Worker ID for matching surveys and participants. The HITS page was the platform where MTurkers learned about and chose tasks to complete.
**Treatment group.** The intervention for the treatment group survey held the audio-visual presentation of the Microsoft Teams lesson. The participant was asked to complete 10 multiple-choice questions about the lesson's information immediately after the video ended. Several studies showed that incorporating quiz questions in video training can improve engagement, reduce mind wandering, and improve retention of material (Cummins, Beresford, & Rice, 2015; Stigler, Geller, & Givvin, 2015). The YouTube video of the Microsoft Teams lesson was embedded into Qualtrics™. When the treatment group participant accessed the audio-visual stimuli, the presentation played on the Qualtrics™ screen. This was accomplished by selecting the “share” option and then “embed” with the video in play mode on YouTube. A code for the path to the video was displayed and copied. The audio-video presentation was two and a half minutes long. The participant was not able to advance to the next screen until the video finished playing.

**Control Group.** The intervention for the control group survey opened with instructions that read, “Please take two and a half minutes to review the Microsoft Teams document below. You will be asked to answer 10 multiple-choice questions regarding the material.” A timer was set so that the participant could not advance the screen until two and a half minutes had passed. This duration was based on the length of the audio-visual lesson.

**Long-Term Working Memory Recall**

Participants who completed the working memory survey were invited to participate in the long-term working memory recall survey (T2) which was administered one-week after the working memory recall survey (see Appendix L). The treatment
group and control group surveys were identical but created independently to keep data separated. The surveys began with a Captcha in the first block. The second block contained the informed consent. The 10 multiple-choice questions and answer choices from the working memory recall survey were presented in the third block with instructions that read, “You recently reviewed some information regarding Microsoft Teams. Your responses are very important to this research. You have five minutes to answer 10 questions. Please, read every question and answer to the best of your ability from memory, without looking up the answers. You will not be penalized for wrong answers, and your survey is anonymous.” Embedded data was set in Qualtrics™, with a code placed in the HIT to capture the MTurk® Worker ID for matching surveys and participants.

**Data Collection**

Participation in this study was voluntary, and as such, the only permission requested was that of the Institutional Review Board (IRB) of The University of Texas at Tyler. The application for IRB approval was submitted before launching the pilot study and was revised based on the proposal’s acceptance for this study by the dissertation committee. All data were collected digitally using an online survey designed using Qualtrics™. A HIT was launched on MTurk® (see Appendix M). On the HITS page, MTurkers saw the requester's name, the title of the survey, compensation, when the HIT was created, the requester’s approval rating, and the average payment review time. Upon accepting the HIT, workers were directed to the Qualtrics™ survey. The literature suggested that MTurk® workers should be compensated at the minimum wage (Chambers & Nimon, 2018; Sheehan, 2018; Silberman et al., 2018). The federal minimum wage is
$7.25 per hour; for this reason, the participants of this study were compensated $0.12 per minute (Texas Workforce Commission, 2015). Stoycheff (2016) reported that when participants who had participated in a Time 1 survey were invited to participate in a new HIT that paid $.50 and $1.00, there was no significant difference in the groups' response rate. However, when participants were invited to participate in a Time 2 follow-up survey and offered a $1.00 bonus, they were significantly more likely to participate in the second survey. Based on Stoycheff (2016) findings, the pay rate offered for Time 1 and Time 2 surveys was advertised as a bonus. To be paid, MTurk® workers had to set-up an account using their Social Security number and PayPal account information. PayPal is an electronic wallet in the sense that it allows MTurk® to securely pay the worker cash without either party knowing the other’s bank information (PayPal, n.d.).

**Prescreening**

A HIT was launched in MTurk® (see Appendix M). MTurk® allowed the researcher to set qualifications (system or premium) that workers must have met before accepting the HIT (Chambers & Nimon, 2018). System qualifications that were free of charge included location, HIT approval rate, and number of HITS approved. The location qualification was set to the U.S. so that only MTurkers with IP addresses in the U.S. could view and complete the survey. The “Masters” only qualification was set so that only MTurkers who had quality performance based on MTurk® analytics could participate. A qualification was set to prohibit pilot study participants from participating in the main study. The HIT title read, “Two-minute survey about you.” The description read, “answer 13 short questions about yourself.” All participants were compensated 25 cents. Silberman et al. (2018) recommended that MTurkers be paid based on the federal
minimum wage of $7.25 per hour ($0.12 per minute). The prescreening survey was estimated to take two minutes. After 458 qualified participants that were representative of the population were received, the subjects were randomly assigned to either the treatment or control group using the randomizR package in R®.

**Intervention and Working Memory Recall**

Two HITS were created to administer the intervention and collect the working memory recall data (i.e., treatment group and control group; see Appendix M). Workers who qualified for the experiment based on the prescreening results had a qualification assigned to them in MTurk®, which allowed them to access the intervention and T1 survey. Qualifications were set using the statistical program R®. One HIT for the treatment group and one HIT for the control group were created. The HITs were available by invitation only. The sample of MTurkers were emailed an invitation to participate in the appropriate survey using the R® program pyMTurkR. The emailed invitation read, "Bonus opportunity: Thank you for completing my HIT. Please complete the follow-up survey to earn $0.60 and an opportunity for a bonus. The survey can be completed by going to your qualifications or searching HITS for Gaby Lambert."

Qualtrics® estimated that the survey would take approximately five minutes to complete. Following the federal minimum wage, the participants were paid 12 cents per minute. Follow-up emails were sent daily until 210 usable surveys were collected.

**Treatment group.** The HIT title for the treatment group read, “watch a two-and-a-half-minute video, then answer 10 multiple-choice questions.” The description read, “answer 10 multiple-choice questions about a video presentation.”
**Control group.** The HIT title for the control group read, “review lesson material for two and a half minutes, then answer 10 multiple-choice questions.” The description read, “answer 10 multiple-choice questions about lesson material.”

**Long-Term Memory Recall**

The participants received an invitation to participate in the Time 2 survey one week after completing the T1 survey. Workers had a qualification assigned to them in MTurk®, which allowed them to access the Time 2 survey. The qualification was set using the R® program. Workers who qualified were emailed a personal invitation, using the R® software. The emailed invitation read, “Bonus Opportunity! Thank you for completing my previous two HITs. Please take two minutes to complete 10 multiple-choice questions to earn $0.50. The survey can be completed by going to your qualifications or searching HITS for Gaby Lambert.” Although the survey was identical for both groups, two HITs were set-up to keep the group data separate. The HIT title stated, “two-minute follow-up multiple-choice survey.” The description read, “Answer 10 multiple-choice questions about the Microsoft Teams material you reviewed last week.” Follow-up emails were sent as needed to encourage participation.

**Data Analysis**

The data analysis process involved a series of procedures. The data were collected in Qualtrics™ and downloaded to CSV files. The CSV files were uploaded to R®, where it was continuously cleaned, starting with 500 surveys to monitor the number of useful responses. Chi-square tests were performed to compare population demographic characteristics (i.e., gender, age, race, education, and occupation) to the sample to assess generalizability. Statistical assumptions were tested, followed by testing
the hypotheses. The prescreening data's statistical and practical significance was assumed at $p \leq 0.05$, Cramèr’s $V \geq 0.39$, respectively (McHugh, 2018; Thompson, 2006). These steps are detailed in the following sections.

**Data Cleaning**

As with any quantitative study, the quality of the research data was imperative. As such, the data were evaluated for invalid and incomplete samples. When each survey is closed, the data were downloaded from Qualtrics™ into two CSV files: text and numeric. The files were uploaded into R® and combined. Then, the data were analyzed to determine if any cases need to be eliminated.

**Prescreening.** The prescreening survey was designed to identify participants who represented the population. Respondents that reported that they had used Microsoft Teams, were not employed, or did not work virtually due to COVID-19 were eliminated. Participants who self-reported a condition that caused memory deficiency, attention deficits, or reading disorders were eliminated. R® was used to identify respondents’ longitude and latitude to ensure that all participants were located in the U.S.

**Intervention and working memory recall.** Four CSV files were downloaded from Qualtrics™: text and numeric for the control and treatment groups. First, the numeric and text CSV files for the control group were uploaded to R® and combined. The data were evaluated, and participants who did not pass the Captcha, did not consent, or did not answer all of the questions were eliminated. The final dataset was saved as a CSV file. Then, the same steps were performed on the control group data. Next, the treatment group CSV file and the control group CSV file were merged using the “Consolidate” feature in Excel. A column was added to identify the groups by “0” for
the treatment group and “1” for the control group. The 10 multiple-choice questions to assess working memory recall was scored as correct answer = 1 and incorrect answer = 0. Scores were totaled for each participant using Excel.

**Long-term memory recall.** Four CSV files were downloaded from Qualtrics™: text and numeric for the control and treatment group. First, the numeric and text CSV files for the control group were uploaded to R® and combined. The data were evaluated, and participants who did not pass the Captcha, did not consent, or did not answer all of the questions were eliminated. The final dataset was saved as a CSV file. Then, the same steps were performed on the treatment group data. Next, the treatment group CSV file and the control group CSV file were merged using the “Consolidate” feature in Excel. A column was added to identify the groups by “1” for the treatment group and “0” for the control group. The 10 multiple-choice questions to assess working memory recall was scored as correct answer = 1 and incorrect answer = 0. Scores were totaled for each participant using Excel.

**Descriptive Statistics**

Descriptive statistics were calculated using R® to portray the essential characteristics of the sample data. Statistical significance was determined at \( p \leq 0.05 \) (Fisher, 1925). The practical significance was determined at \( d \geq 0.50 \) (Cohen, 1988). As suggested by Field et al. (2012), skewness and kurtosis were converted to \( z \)-scores by dividing the values by their standard error. Skewness and kurtosis were determined to be statistically significantly different than 0, when the absolute value of the \( z \)-scores were greater than 1.96 (Field et al., 2012). Descriptive statistics were reported for the total
sample (control group and treatment group), the control group, and the treatment group (McHugh & Hudson-Barr, 2003).

**Chi-Square Tests**

To gauge sample representativeness of the population, Kline (2009) advised to “compare the sample demographic profile with that of the population” (p. 68). Five chi-square tests were performed to compare the population demographic percentages (gender, age, race, educational attainment, and occupation) to the ratios of the same demographics collected for the sample. A chi-square $p < 0.05$ indicated that the sample was statistically different from the population (Knapp, 2018). Practical significance was assessed by Cramèr’s $V$. $V 0.39 – 0.50$, which indicates a moderate correlation (McHugh, 2018). As such, the desired outcome of the Chi-square tests was $p \geq 0.05$; Cramèr’s $V \leq 0.39$.

**Statistical Assumptions**

All statistical measures have steadfast assumptions that must be complied with to assert that test results are valid. There were four assumptions of the $t$ test: (1) normal distribution, (2) interval level data, and (3) scores were independent (Field, Miles, & Field, 2012), and (4) homogeneity of variance. First, normal distribution was assessed by skewness and kurtosis. Data were judged as normally distributed when the absolute value of the z-score of kurtosis was less than 1.96 (Field et al, 2012). Second, interval-level data means that each measurement point was an equal distance apart (Field et al., 2012). The current study data where each question was worth either zero or one point, satisfying the assumption of interval level data. Third, test subjects were assigned to the treatment or control group. Once assignments were made, subjects were only able to
access the test for their group. The assumption of independent scores was met since subjects were not able to participate in both groups. Lastly, the homogeneity of variance was measured using Levene’s test and was assumed at $p \geq 0.05$.

**t test**

$t$ tests were conducted using the summed scores per subject. Campbell and Stanley (1963) suggested that $t$ tests are optimal for the research design used in this study. Ploeger-Lyons (2017) stated that the $t$ test is the “most frequently used statistical measures in communication research” (p. 1789). While the test items influence data, the sample's characteristics also manipulate reliability (Chretien, Nimon, Reio, & Lewis, 2020). However, a reliability analysis of right or wrong answer data is not statistically optimal (Zhu & Lowe, 2018). Statistical significance was determined at $p \leq 0.05$ (Fisher, 1925) and practical significance at $d \geq 0.50$ (Cohen, 1988).

**Internal and External Validity**

Campbell and Stanley (1963) outlined eight threats to internal validity and four threats to external validity. This section discussed the steps that were taken to mediate these 12 threats to internal and external validity.

**Internal validity.** Internal validity acknowledges the precision of inferences about the causal relationship between two variables (Leighton, 2010). In this study, the hypothesized causal relationship was between the presentation medium (independent variable) and the presentation delivery mode (dependent variable). The purpose of assessing internal validity was to rule out potential causal factors, other than communication medium, which may have influenced this study (Daily, 2017).

**History.** The events that occur between the first and second measurements can influence the study (Campbell & Stanley, 1963). History was a threat to validity when
data are collected at more than one observation on the same participants (Drew, Hardman, & Hosp, 2008). History is commonly a threat in a pre-post-test or time-series design where the same variable is measured on the same participants on two occasions (Drew et al., 2008). While the current experiment collected data on two observations from the same participants, history was a minimal threat to this study's validity for the following reasons. First, the initial data collection was intended as a prescreening method to identify the sample for the experiment. As such, the data from the first collection was not be statistically analyzed for experiment outcomes. Second, history could have effected this study if an event occurred where participants were made aware of the consequences of not thoroughly following instructions. For example, suppose a participant in this study had recently been denied payment for failing to follow instructions on a HIT. As a result, the participant was more focused during the current experiment than usual. Third, with a sample of 140, history biasing the results for one participant was negligible to this study's results. Lastly, as detailed, the probability of history influencing enough participants to skew this study's outcome was highly unlikely.

**Maturation.** Campbell and Stanley (1963) explained maturation as the effects of time passing on the respondent, such as growing tired and getting hungry. Drew et al. (2008) suggested that maturation is commonly a concern in repeated measures studies. Maturation was a nominal threat to the validity of the prescreening survey since measurement took approximately three minutes. Maturation on the experimental intervention (Time 1) was a more significant concern due to the intervention's length. The threat of maturation on the long-term memory recall survey (Time 2) was a concern due to the time lapse since Time 1. Assurances against the threat of maturation were
implemented in the experimental design. First, before accepting the prescreening HIT, MTurkers were informed that participation would take approximately three minutes. Second, participants were informed on the consents, the amount of time the task would take. Lastly, participants were compensated well for completing the experiment.

**Testing.** Testing, or test practice, was a threat to validity when the effects of taking a test influence the scores of a second test (Campbell & Stanley, 1963; Drew et al., 2008). The threat to validity due to testing was addressed in the design of this experiment. Testing is usually a concern for a pre-post-test design where the sequence is a test-intervention-test (Drew et al., 2008). While the current design collected data on three occasions, no test measures were collected before the intervention. There was a concern that the effects of taking the Time 1 test would influence the Test 2 scores. Drew et al. (2008) stated that “if participants clearly have a background that includes experience on the measurement instrument, an investigator may assume that test practice will generate less performance change and therefore be less of a threat” (p. 220). Also, Baddeley’s model of working memory, the foundation of this study, suggested that the repetition of information is the process that transports information from working memory to long-term memory (Baddeley, 2010). Following Baddeley’s model, validity was not threatened due to testing. The subjects were not informed of the correct answers in T1. The Time 2 survey questions were presented in random order (Butler et al., 2007; Cantor et al., 2015). Pearson’s (2020) TestGen test generator was used to scramble the questions and answer choices for the long-term working memory recall (T2).

**Instrumentation.** Campbell and Stanley (1963) explained instrumentation as changes in the calibration of an instrument or changes in the observers, resulting in
changes in the procured measurement. The current experiment did not involve human observers, which eliminated the threat of validity due to data collector characteristics. The assessment remained the same throughout the experiment and did not require calibration.

**Statistical regression.** Statistical regression is a threat to validity when observation groups are manually selected based on their extreme scores (Campbell & Stanley, 1963). Groups were randomly selected using the statistical package randomizR before data containing scores were collected.

**Bias in group composition.** This occurs when there are systematic differences in the comparison groups (Campbell & Stanley, 1963; Drew et al., 2008). Bias in group composition was a threat to this study since the population was identified and sampled in advance of the experiment; thus, the participants are alike until the experimental treatment initiates (Drew et al., 2008). To control for bias in group composition, participants were completely randomly assigned to the treatment or control group. Lavene’s test was performed using R® to assess group equivalence.

**Experimental mortality.** Experimental mortality occurs when attrition is unbalanced between the groups (Campbell & Stanley, 1963). Drew et al. (2008) suggested that experimental mortality is not a threat to validity if participants' loss is equal among the groups. Experimental mortality was addressed in the design of this study.

**Hawthorne effect.** The Hawthorne effect occurs when participants act uncharacteristically due to knowing they are being evaluated in an experiment (Drew et al., 2008). The threat to validity due to the Hawthorne effect was considered in the
current study's experimental design. This study was carried out entirely anonymously using an online platform. This method of data collection mitigated the threat to validity since the researcher completed the experiment without interaction with participants; participants did not know they are in an experiment. The participants were unaware that they were being compared to a group of individuals who had received the same task with instructions from a different communication medium (Paolacci, Chandler, & Ipeirotis, 2010).

**External validity.** External validity is concerned with the extent to which the observed variables in one sample of a population will be consistent with other samples in the same population or other populations (Mitchell, 2018). Hanasono (2017) explained that external validity is analogous to generalizability. The following section assessed external validity for the threats that may have interfered with generalizing the results from this study across all employed U.S. workers.

**The reactive or interaction effect.** Drew et al. (2008) refer to this as the pretest influence. A pretest can bias the participant's response to the experimental variable (Campbell & Stanley, 1963). This threat to validity was a concern for the current study and was contemplated during the research design. Based on the context of the experimental variable (audio-visual presentation and visual-only presentation), the measurement could be a threat. For example, if the same subjects received both audio-visual and text presentation, they would be aware of the experiment's idiosyncrasies from the first task assignment that would have a direct effect on how they respond to the second task assignment. The threat of an interaction effect was attended to by experimental design. To extenuate this threat, participants only received the presentation
of the material in one medium. The allocation to groups was completely randomly selected (Campbell & Stanley, 1963).

**The interaction effects of selection biases and the experimental variable.** The interaction effects of selection biases and the experimental variable are the population-sample differences (Drew et al., 2008). A randomly selected sample is genuinely representative (Ruel, Wagner, & Gillespie, 2016). Still, the degree to which the sample in the current study was representative of the population identified was a significant concern. This threat was addressed in the design of the experiment. First, the population identified for the prescreening survey was made up of employed U.S. residents. As such, demographic information reported by the Bureau of Labor Statistics (i.e., generational cohort, race, educational attainment, occupation, and industry) was collected with the prescreening data. A chi-square test was performed to measure how well the sample generalized to the population (Parke, 2013).

**Reactive effects of experimental arrangements.** Sometimes referred to as artificial research arrangements, these effects are a threat to validity when the context of the research diverts from the subject’s norm (Drew et al., 2008). The use of MTurk® to recruit participants naturally alleviated the concern for this threat to validity. It is routine for MTurkers to log onto MTurk® and browse the HITs for a task. Martin, Hanrahan, O'Neill, and Gupta (2014) found that MTurkers participate in HITs for fun and to gain knowledge. As such, participation in the current study was not out of character for the subjects, thereby circumventing the threat of reactive effects.

**Multiple-treatment interference.** Multiple-treatment interference is a threat to validity when a participant receives more than one treatment. Since the previous
treatment experience cannot be forgotten, the knowledge affects how the subject responds to the subsequent treatment. Participants were only exposed to one treatment. Accordingly, multiple-treatment interference was of no concern for this experiment.

**Limitations**

As with any study, this experimental design had several limitations that were considered when analyzing causality. First, there were three limitations to using MTurk® for the recruitment of participants. Given that the experiment was performed online, there was ambiguity about the subjects’ exact identity (Horton et al., 2011). Another limitation was the use of online MTurk® discussion boards where MTurkers could discuss the content of tasks they have completed or share HITs that they found interesting. Had such a discussion occurred, it could have affected the outcome of the current study. An expectation of the MTurkers not to discuss the survey with others was added to the informed consent to discourage the behavior. Individuals who chose to be MTurk® workers represented a small sample of the population; thus, the sample may not have been generalizable to the desired population.

Second, there was a limitation to the measurements used for data collections. Participants in the experiment were not clinically evaluated, so a diagnosis of memory deficits or reading disorders was based on self-assessment.

Third, there were limitations to the data collection of the study. First, although the sample was completely randomized, some factors were not controlled for, which could have affected causality. For example, the level of intelligence or English not being the participant’s first language could have potentially affected causality. Being an online experiment, the researcher had no control over the environment for which the data
collection occurred. Fundamentally, factors of the subject’s environment could have skewed causality. For instance, the participant could have had a surprise visitor during the experiment, which inherently distracted the subject. In this case, the cause for poor performance may have been the interruption rather than the intervention.

Fourth, the training material used in the study was developed by Microsoft. The researcher was not able to alter the training materials. The quality of instructional design and theory used were not able to be assessed.

Chapter Summary

This chapter described the methods and design of the study. First, the purpose of the study and research hypotheses were restated. Next, the population and sample, sample frame, and sample representativeness were detailed. Then, the research design provided an in-depth recount of the material, stimuli, and measures. Afterward, the survey design was comprehensively explained, followed by a summary of the pilot study. Ultimately, the data collection procedures, data analysis procedures (data cleaning, descriptive statistics, statistical assumptions, and hypotheses testing), validity, and limitations were discussed.
Chapter 4 - Results

Introduction

This chapter informs and discusses the results of the study. First, the data were collected, and the results of the data cleaning are reviewed. Then, sample representativeness and group comparison are discussed. Next, descriptive statistics are reported. Lastly, statistical assumptions are addressed and test results are reported. The chapter concludes with a summary.

Data Analysis Results

The purpose of this study was to evaluate the modality effect by examining the effect that learning content presented in a visual-only format compared to an audio-visual mode has on working, and long-term memory recall in the context of a virtual workplace tool training module presented to employees who became virtual workers due to the COVID-19 pandemic. As suggested by Baddeley and Hitch (1974), working memory was assessed immediately after the intervention. Long-term memory was evaluated one week after the intervention (Segers et al., 2008; Witteman & Segers, 2010). The online survey platform Qualtrics™ was utilized to collect data at three points in time (i.e., prescreening, T1, and T2). Study participants were recruited with the assistance of MTurk®, and the respondents’ data across the three waves were matched via the MTurk® WorkerID. After the prescreening survey identified the sample, groups were randomly assigned, and chi-square tests confirmed that the groups were equally distributed with p-values ranging from 0.10 to 0.80, and Cramér’s V coefficients ranging from 0.01 – 0.07. Then, an experiment was performed using two randomly assigned groups, treatment, and control.
Data Collection and Participants

Before collecting data, research permission was requested from the Institutional Review Board (IRB) of The University of Texas at Tyler (see Appendix O). The data collection took place between August 6, 2020, and August 29, 2020. Participants were automatically paid through MTurk® within one hour of completing each of the surveys. The data collected from the five surveys were retrieved from Qualtrics® as CSV files and cleaned using the software packages R® 4.0.2. A summary of the data collection for the five surveys was presented in Table 9. The results unique to each of the three data collection points are detailed in the following sections.

Table 9
Summary of Data Collection

<table>
<thead>
<tr>
<th>Survey</th>
<th>Group</th>
<th>Invited to Participate</th>
<th>Participated</th>
<th>Qualified Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescreening</td>
<td>Sample</td>
<td>4,924</td>
<td>458</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Treatment</td>
<td></td>
<td>229</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td></td>
<td>229</td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>Sample</td>
<td>458</td>
<td>305</td>
<td>305</td>
</tr>
<tr>
<td></td>
<td>Treatment</td>
<td></td>
<td>229</td>
<td>162</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td></td>
<td>229</td>
<td>143</td>
</tr>
<tr>
<td>T2</td>
<td>Sample</td>
<td>305</td>
<td>221</td>
<td>221</td>
</tr>
<tr>
<td></td>
<td>Treatment</td>
<td></td>
<td>162</td>
<td>122</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td></td>
<td>143</td>
<td>99</td>
</tr>
</tbody>
</table>
Prescreening

Work characteristics, memory issues, and demographics were collected in the prescreening survey to identify those qualified for the experiment. A total of 4,924 responses were collected. First, the IP address was removed for each respondent to ensure anonymity. Then, responses were removed because they did not meet the sample requirements:

- 2,565 were not working virtually due to the COVID-19 pandemic
- 1,781 were familiar with Microsoft Teams
- 74 self-reported a permanent memory impairment from a traumatic brain injury, concussion, or stroke
- 46 self-reported attention issues due to ADHD

A total of 458 participants qualified to participate in the experiment. First, Pearson’s chi-square tests were performed to assess how well the sample represented the U.S. working population for the five demographics (i.e., gender, age, race, educational attainment, and occupation). The groups were judged to be statistically significantly similar when $p \geq 0.05$ (Knapp, 2018), and practically significantly similar when Cramèr’s $V \leq 0.39$ (McHugh, 2018). The tests suggested that the sample was statistically significantly younger ($p = 0.02$), more educated ($p < 0.01$), and more diverse in their occupations ($p = 0.03$) compared to the population. However, these findings were not practically significant (Cramèr’s $V = 0.10, 0.21, 0.10$), respectively. Therefore, no change was made to the sample (see Table 10).
Table 10

Demographics and Chi-Square Test Results Comparing the Prescreening Sample to the U.S. Population.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>U.S.</th>
<th>Pooled sample n = 458</th>
<th>( \chi^2 )</th>
<th>( p )-value</th>
<th>Cramèr’s V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>52%</td>
<td>52%</td>
<td>&lt; 0.01</td>
<td>0.97</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Women</td>
<td>48%</td>
<td>48%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td>4.99</td>
<td>0.02</td>
<td>0.10</td>
</tr>
<tr>
<td>18 – 34</td>
<td>34%</td>
<td>39%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35+</td>
<td>66%</td>
<td>61%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td>3.50</td>
<td>0.06</td>
<td>0.09</td>
</tr>
<tr>
<td>Caucasian</td>
<td>67%</td>
<td>71%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>33%</td>
<td>29%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>College education</td>
<td></td>
<td></td>
<td>20.77</td>
<td>&lt; 0.01</td>
<td>0.21</td>
</tr>
<tr>
<td>No</td>
<td>33%</td>
<td>23%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>67%</td>
<td>77%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
<td></td>
<td>4.64</td>
<td>0.03</td>
<td>0.10</td>
</tr>
<tr>
<td>Professional</td>
<td>62%</td>
<td>57%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>38%</td>
<td>43%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Next, the qualified participants were randomly assigned to the treatment group \((n_{T1-nt} = 229)\) or the control group \((n_{T1-cntl} = 229)\) using the R® package, RandomizR. Chi-square tests showed that the groups were significantly statistically equal for the demographics (i.e., gender, age, race, educational attainment, and occupation) with \( p \)-values ranging from 0.10 – 0.80, and practically significant with Cramèr’s \( V = 0.01 – 0.07 \) (see Table 11).
Table 11

Demographics and Chi-Square Test Results Comparing the Prescreened Treatment Group to the Prescreened Control Group.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Treatment (n = 229)</th>
<th>Control (n = 229)</th>
<th>(\chi^2)</th>
<th>(p)-value</th>
<th>Cramèr’s V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>51%</td>
<td>52%</td>
<td>0.08</td>
<td>0.80</td>
<td>0.01</td>
</tr>
<tr>
<td>Women</td>
<td>49%</td>
<td>48%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 – 34</td>
<td>41%</td>
<td>38%</td>
<td>0.30</td>
<td>0.60</td>
<td>0.03</td>
</tr>
<tr>
<td>35+</td>
<td>59%</td>
<td>62%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>70%</td>
<td>72%</td>
<td>0.40</td>
<td>0.50</td>
<td>0.03</td>
</tr>
<tr>
<td>Other</td>
<td>30%</td>
<td>28%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>College education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>25%</td>
<td>20%</td>
<td>2.00</td>
<td>0.10</td>
<td>0.07</td>
</tr>
<tr>
<td>Yes</td>
<td>75%</td>
<td>80%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional</td>
<td>55%</td>
<td>60%</td>
<td>1.00</td>
<td>0.30</td>
<td>0.05</td>
</tr>
<tr>
<td>Other</td>
<td>45%</td>
<td>40%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. \(df = 1\).

T1

An email invitation to participate in T1 was sent to the 458 qualified participants using the statistical software R®. Of those, 162 participants from the treatment group and 143 from the control group responded and completed the survey for a 71% and 62% response rate, respectively. A chi-square test suggested that the response rate between groups was not statistically or practically significantly different, \(\chi^2(1) = 4.00, \ p = 0.06\), Cramèr’s \(V = 0.09\). None of the surveys were eliminated for nonconsenting, failing the Captcha, incomplete, or straight-lining.

Chi-square tests were performed to compare the sample demographics (i.e., gender, age, race, educational attainment, and occupation) to population information
obtained from the BLS and the USCB. The groups were judged to be statistically significantly similar when \( p \leq 0.05 \) (Knapp, 2018), and practically significantly similar when Cramèr’s \( V \leq 0.39 \) (McHugh, 2018). Test results suggested that the sample was statistically significantly younger than the working U.S. population \( (p = 0.03) \) and more educated \( (p < 0.01) \). However, these findings were not practically significant, Cramèr’s \( V = 0.12 \) and 0.19, respectively (see Table 12). Since these findings were not practically significant, no changes were made to the sample.

Table 12

*Demographics and Chi-Square Test Results Comparing the U.S. Population to the Time 1 Sample.*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>U.S.</th>
<th>Sample ( N_{T1} = 305 )</th>
<th>( \chi^2 )</th>
<th>( p )-value</th>
<th>Cramèr’s ( V )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>52%</td>
<td>52%</td>
<td>&lt; 0.01</td>
<td>0.99</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Women</td>
<td>48%</td>
<td>48%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td>4.74</td>
<td>0.03</td>
<td>0.12</td>
</tr>
<tr>
<td>18 – 34</td>
<td>34%</td>
<td>40%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35+</td>
<td>66%</td>
<td>60%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td>0.59</td>
<td>0.44</td>
<td>0.04</td>
</tr>
<tr>
<td>Caucasian</td>
<td>67%</td>
<td>69%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>33%</td>
<td>31%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>College education</td>
<td></td>
<td></td>
<td>11.11</td>
<td>&lt; 0.01</td>
<td>0.19</td>
</tr>
<tr>
<td>No</td>
<td>33%</td>
<td>24%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>67%</td>
<td>76%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
<td></td>
<td>2.17</td>
<td>0.14</td>
<td>0.08</td>
</tr>
<tr>
<td>Professional</td>
<td>62%</td>
<td>58%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>38%</td>
<td>42%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Next, five chi-square tests were performed to compare the demographics (i.e., gender, age, race, educational attainment, and occupation) of the treatment group ($n_{T1-tmt} = 162$) to the control group ($n_{T1-cntl} = 143$) to assess group equivalence. Test results suggested that the groups were statistically significantly similar with $p$-values ranging from 0.30–0.80 and practically significantly similar with Cramér’s $V$ ranging 0.01 to 0.06 (see Table 13).

Table 13

Demographics and Chi-Square Results Comparing the Time 1 Treatment Group to the Time 1 Control Group.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Treatment $n_{T1-tmt} = 162$</th>
<th>Control $n_{T1-cntl} = 143$</th>
<th>$\chi^2$</th>
<th>$p$-value</th>
<th>Cramér’s $V$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>52%</td>
<td>51%</td>
<td>0.06</td>
<td>0.80</td>
<td>0.01</td>
</tr>
<tr>
<td>Women</td>
<td>48%</td>
<td>49%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 – 34</td>
<td>38%</td>
<td>43%</td>
<td>0.80</td>
<td>0.40</td>
<td>0.05</td>
</tr>
<tr>
<td>35+</td>
<td>62%</td>
<td>57%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>71%</td>
<td>67%</td>
<td>0.50</td>
<td>0.50</td>
<td>0.04</td>
</tr>
<tr>
<td>Other</td>
<td>29%</td>
<td>33%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>College education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>27%</td>
<td>21%</td>
<td>1.00</td>
<td>0.30</td>
<td>0.06</td>
</tr>
<tr>
<td>Yes</td>
<td>73%</td>
<td>79%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional</td>
<td>57%</td>
<td>59%</td>
<td>0.06</td>
<td>0.80</td>
<td>0.01</td>
</tr>
<tr>
<td>Other</td>
<td>43%</td>
<td>41%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. $df = 1.$

Next, the demographics (i.e., gender, age, race, educational attainment, and occupation) of the participants that did not respond to T1 (prescreen only, $n = 153$) were
compared to those who did respond to T1 (sample, $n_{T1} = 305$) to evaluate for nonresponse bias. Nonresponse bias is the possible bias that can arise in data due to nonresponse (Krishnamurty, 2018). Lavrakas (2004) explained that “whenever nonresponding elements differ from the responding elements on the measures of interest, then nonresponse error occurs, most typically in the form of bias” (p. 742). The chi-square tests did not indicate nonresponse bias with $p$-values ranging from 0.20 to 0.90 and Cramèr’s Vs from < 0.01 to 0.05 (see Table 14).

Table 14

<table>
<thead>
<tr>
<th>T1 Nonresponse Bias Chi-Square Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristic</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>Men</td>
</tr>
<tr>
<td>Women</td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td>18 – 34</td>
</tr>
<tr>
<td>35+</td>
</tr>
<tr>
<td>Race</td>
</tr>
<tr>
<td>Caucasian</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>College education</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>Occupation</td>
</tr>
<tr>
<td>Professional</td>
</tr>
<tr>
<td>Other</td>
</tr>
</tbody>
</table>

Note. $df = 1.$

T2

One week after the distribution of T1, the T2 treatment group ($n_{T2-tmt} = 162$) and the control group ($n_{T2-cntl} = 143$) surveys were disseminated for the T2 data collection. An email invitation to participate was sent to the 305 qualified participants using the
statistical software R\textsuperscript{®}. Of those, 122 participants from the treatment group and 99 from the control group responded and completed the survey for a 75\% and 69\% response rate, respectively. A chi-square test suggested that the response rate between groups was not statistically or practically significantly different, $\chi^2 (1) = 1, p = 0.20$, Cramèr’s $V = 0.06$. No surveys were eliminated for nonconsenting, failing the Captcha, incomplete, or straight-lining. Chi-square tests were performed to compare the sample demographics (i.e., gender, age, race, educational attainment, and occupation) to population information obtained from the BLS and the USCB. The groups were judged to be statistically significantly similar when $p \geq 0.05$ (Knapp, 2018), and practically significantly similar when Cramèr’s $V \leq 0.39$ (McHugh, 2018). The tests suggested that the sample was statistically significantly representative of the U.S. working population with $p$-values ranging from 0.10 to 0.55 and practically significant with Cramèr’s $V$ ranging from 0.04 to 0.11 (see Table 15).
Table 15
Demographics and Chi-Square Test Results Comparing the U.S. Population to the Time 2 Sample.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>U.S. N = 221</th>
<th>Sample N = 221</th>
<th>$\chi^2$</th>
<th>p-value</th>
<th>Cramèr’s V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>52%</td>
<td>50%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>48%</td>
<td>50%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 - 34</td>
<td>34%</td>
<td>38%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35+</td>
<td>66%</td>
<td>62%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>67%</td>
<td>69%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>33%</td>
<td>31%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>College education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>33%</td>
<td>28%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>67%</td>
<td>72%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional</td>
<td>62%</td>
<td>57%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>38%</td>
<td>43%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Next, five chi-square tests were performed to compare the demographics (i.e., gender, age, race, educational attainment, and occupation) of the treatment group ($n_{T2-tmt} = 122$) to the control group ($n_{T2-cntl} = 99$) to assess group equivalence. Test results suggested that the groups were not statistically or practically significantly different, with $p$-values ranging from 0.30 to 0.80 and Cramèr’s $V$ from 0.02 to 0.07 (see Table 16).
Table 16
Demographics and Chi-Square Results Comparing the Time 2 Treatment Group to the Time 2 Control Group.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Treatment $n_{T2-tmt} =$ 122</th>
<th>Control $n_{T2-cntl} =$ 99</th>
<th>$\chi^2$</th>
<th>p-value</th>
<th>Cramèr’s $V$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>53%</td>
<td>46%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>47%</td>
<td>54%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 – 34</td>
<td>36%</td>
<td>39%</td>
<td>0.30</td>
<td>0.60</td>
<td>0.04</td>
</tr>
<tr>
<td>35+</td>
<td>64%</td>
<td>61%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>70%</td>
<td>68%</td>
<td>0.010</td>
<td>0.80</td>
<td>0.02</td>
</tr>
<tr>
<td>Other</td>
<td>30%</td>
<td>32%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>College education</td>
<td></td>
<td></td>
<td>0.30</td>
<td>0.60</td>
<td>0.04</td>
</tr>
<tr>
<td>No</td>
<td>30%</td>
<td>26%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>70%</td>
<td>74%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
<td></td>
<td>0.50</td>
<td>0.50</td>
<td>0.05</td>
</tr>
<tr>
<td>Professional</td>
<td>54%</td>
<td>62%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>46%</td>
<td>38%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. df = 1.*

Next, the demographics (i.e., gender, age, race, educational attainment, and occupation) of those who did not respond to T2 ($n = 84$) were compared to those who did respond to T2 ($n_{T2} = 221$) and assessed for nonresponse bias. The chi-square tests suggested that the data were statistically significantly biased by the nonresponse of college-educated participants ($p < 0.01$); however, these findings were not practically significant (Cramèr’s $V = 0.15$). The data were judged not to be biased by nonresponse (see Table 17).
Table 17

T2 Nonresponse Bias Chi-Square Test Results.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>T1-only $n_1 = 84$</th>
<th>Sample $n_2 = 221$</th>
<th>$\chi^2$</th>
<th>$p$-value</th>
<th>Cramèr’s V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>56%</td>
<td>50%</td>
<td>0.80</td>
<td>0.40</td>
<td>0.05</td>
</tr>
<tr>
<td>Women</td>
<td>44%</td>
<td>50%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 – 34</td>
<td>46%</td>
<td>38%</td>
<td>2.00</td>
<td>0.20</td>
<td>0.08</td>
</tr>
<tr>
<td>35+</td>
<td>54%</td>
<td>62%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>70%</td>
<td>69%</td>
<td>0.06</td>
<td>0.80</td>
<td>0.01</td>
</tr>
<tr>
<td>Other</td>
<td>30%</td>
<td>31%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>College education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>13%</td>
<td>28%</td>
<td>7.00</td>
<td>&lt; 0.01</td>
<td>0.15</td>
</tr>
<tr>
<td>Yes</td>
<td>87%</td>
<td>72%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional</td>
<td>61%</td>
<td>57%</td>
<td>0.30</td>
<td>0.60</td>
<td>0.03</td>
</tr>
<tr>
<td>Other</td>
<td>39%</td>
<td>43%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. df = 1.*

Descriptive Statistics

Descriptive statistics were calculated using R® to portray the essential characteristics of the sample data. As suggested by McHugh & Hudson-Barr (2003), descriptive statistics are reported in Table 18 for the T1 sample ($N_{T1} = 305$), T1 treatment group ($n_{T1-tmt} = 162$), T1 control group ($n_{T1-cntl} = 143$), T2 sample ($N_2 = 221$), T2 treatment group ($n_{T2-tmt} = 122$), and T2 control group ($n_{T2-cntl} = 99$; see Table 18). The symmetry of the data were evaluated by the skewness (Taylor, 2008), and normal distribution was determined by kurtosis (Cameron, 2004; Richardson, 2018; Taylor, 2008). As suggested by Field et al. (2012), skewness and kurtosis were converted to z-scores by dividing the values by their standard error. Evaluating skewness and kurtosis by z-scores allows the
researcher to “see how likely our values of skew and kurtosis are to occur” (p. 174).

Field et al. warned that large samples would generate small standard errors, so the shape of the distribution was assessed visually (see Figures 9 and 10).

**Figure 7.** Distribution of T1 data.

**Figure 8.** Distribution of T2 data.
Table 18

*Descriptive Statistics for the Pooled Sample, Treatment Group, and Control Group for T1 and T2.*

<table>
<thead>
<tr>
<th>Sample</th>
<th>n</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>SD</th>
<th>Skewness</th>
<th>Zskewness (SE)</th>
<th>Kurtosis</th>
<th>ZKurtosis (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>T1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample</td>
<td>305</td>
<td>0</td>
<td>10</td>
<td>4.86</td>
<td>2.25</td>
<td>0.01</td>
<td>0.08 (0.14)</td>
<td>-0.59</td>
<td>-2.13 (0.28)</td>
</tr>
<tr>
<td>Treatment Group</td>
<td>162</td>
<td>0</td>
<td>10</td>
<td>5.59</td>
<td>2.25</td>
<td>-0.24</td>
<td>-1.27 (0.19)</td>
<td>-0.56</td>
<td>-1.49 (0.38)</td>
</tr>
<tr>
<td>Control Group</td>
<td>143</td>
<td>0</td>
<td>9</td>
<td>4.04</td>
<td>1.94</td>
<td>0.03</td>
<td>0.17 (0.20)</td>
<td>-0.45</td>
<td>-2.86 (0.40)</td>
</tr>
<tr>
<td><strong>T2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample</td>
<td>221</td>
<td>1</td>
<td>8</td>
<td>4.38</td>
<td>1.76</td>
<td>0.03</td>
<td>0.16 (0.21)</td>
<td>-0.57</td>
<td>0.33 (-1.76)</td>
</tr>
<tr>
<td>Treatment Group</td>
<td>122</td>
<td>1</td>
<td>8</td>
<td>4.56</td>
<td>1.93</td>
<td>-0.86</td>
<td>0.31 (0.22)</td>
<td>-0.86</td>
<td>-1.98 (0.43)</td>
</tr>
<tr>
<td>Control Group</td>
<td>99</td>
<td>1</td>
<td>7</td>
<td>4.17</td>
<td>1.51</td>
<td>-0.34</td>
<td>-1.38 (0.24)</td>
<td>-0.46</td>
<td>-1.38 (0.48)</td>
</tr>
</tbody>
</table>
Statistical Assumptions

To ensure that the t test results are valid, four assumptions were addressed. First, normal distribution was assessed by skewness and kurtosis. Data were judged as normally distributed with $Z_{\text{kurtosis}}$ below 1.96 (Field et al., 2012). The data suggested that the assumption of normal distribution was not severely violated. While there were some slight violations, Boneau (1960) suggested that the t test is robust to unequal group sizes and nonnormality. Second, the assumption of independence was met since there was no convergence between the groups. Third, the data met the assumption of interval level data. Lastly, the homogeneity of variance was measured using Levene’s test and was assumed to be statistically different at $p \leq 0.05$ (Field et al., 2012). The Levene’s test indicated that the assumption of homogeneity of variance was not met across groups for T1, $F(1, 303) = 4.44, p = 0.04$ nor T2, $F(1, 219) = 5.89, p = 0.02$ Since the assumption homogeneity of variance was not met, a Welch two sample t test was performed using R® with variance equal set to false.

Welch Two Sample t Test

For the t tests, statistical significance was determined at $p \leq 0.05$ (Fisher, 1925). Practical significance was determined at $d > 0.50$ (Cohen, 1988).

**T1.** The t test results for time 1 ($t[303] = 6.40, p < 0.01, d = 0.73$) indicated that the mean score from the treatment group ($n_{T1-tmt} = 162, M = 5.59, SD = 2.25$) was statistically and practically significantly different than the control group ($n_{T1-ctl} = 143, M = 4.04, SD = 1.94$). These results provide support for Hypothesis 1, virtual workers who receive training material in an audio-visual format will have better working memory.
recall than virtual workers who receive training material in a visual-only format as measured by a posttest assessment of Microsoft Teams functionality knowledge.

T2. The t test results for time 2 ($t[219] = 1.70, \ p = 0.10, \ d = 0.22$) indicated that the mean score from the treatment group ($n_{T2-tmt} = 122, \ M = 4.56, \ SD = 1.93$) was statistically and practically significantly different the control group ($n_{T2-tmt} = 99, \ M = 4.17, \ SD = 1.51$). Although the treatment group outperformed the control group, the small effect size did not provide support for Hypothesis 2, *virtual workers who receive training material in an audio-visual format will have better long-term memory recall than virtual workers who receive training material in a visual-only format as measured by a one-week posttest assessment of Microsoft Teams functionality knowledge.*

**Chapter Summary**

This chapter informed and discussed the results of the study. First, the data collection and cleaning processes were reviewed. Then, sample representativeness was supported, and group comparisons were examined. Next, the descriptive statistics were reported. Lastly, statistical assumptions were addressed, and test results indicated a statistical and practical significance for the modality effect in T1 but not in T2.
Chapter 5 - Discussion

Introduction

This chapter encompasses five sections. First, the results from Chapter 4 and their relationships to relevant literature are discussed. Second, implications to theory, research, HRD practitioners, and complementary fields of study are considered. Then, the limitations of the study are examined. Fourth, suggestions for future research are provided. Fifth, the chapter closes with a summary.

Summary of Study and Discussion of Results

The purpose of this study was to evaluate the modality effect by examining the effect that learning content presented in a visual-only format compared to an audio-visual form has on working, and long-term memory recall in the context of a virtual workplace tool training module presented to virtual employees. Based on Baddeley’s working memory model and the modality effect, the study’s research hypotheses predicted that virtual employees who receive learning material in an audio-visual mode would outperform virtual employees who receive learning material in a visual-only mode on posttest assessments. The study hypothesized:

Hypothesis 1: Virtual workers who receive training material in an audio-visual format will have better working memory recall than virtual workers who receive training material in a visual-only format as measured by a posttest assessment of Microsoft Teams functionality knowledge.
**Hypothesis 2:** Virtual workers who receive training material in an audio-visual format will have better long-term memory recall than virtual workers who receive training material in a visual-only format as measured by a one-week posttest assessment of Microsoft Teams functionality knowledge.

To test the research hypotheses, a random experimental design was performed with data collected at three stages (i.e., prescreening, T1, T2). U.S. employees who were working virtually due to COVID-19 were chosen for this study. Experiment participants were recruited through the online crowdsourcing platform, MTurk®. In response, 4,924 MTurk® workers responded to the prescreening survey. Of those, 458 qualified to participate in the experiment and were randomly assigned to the treatment group ($n_{tmt} = 229$) and control group ($n_{cntl} = 229$). Of these, 71% from the treatment group ($n_{tmt} = 162$) and 62% of the control group ($n_{cntl} = 143$) responded to T1 and 75% of the treatment group ($n_{tmt} = 122$) and 69% of the control group ($n_{cntl} = 99$) responded to T2. As discussed in Chapter 4, chi-square tests, Levene’s tests, and $t$ tests were performed to analyze the data.

**Working Memory - Hypothesis 1**

Hypothesis 1 predicted that the group that received training material in an audio-visual format would have better working memory recall than the group who received the same training material in a visual-only format. Baddeley and Hitch (1974) evidenced the presence of a working memory system that played a crucial role in human information processing. Underpinned by Baddeley’s working memory model, the modality effect proposed that “learning will be enhanced if textual information is presented in an auditory format, rather than the usual visual format, when accompanying related visually
based information, such as a graph, diagram or animation” (Ginns, 2005, pp. 314-314).

Previous studies have reported empirical evidence of the modality effect in a higher education setting (Mayer et al., 2003; Mayer & Moreno, 1998; Moreno & Mayer, 1999; Moreno et al., 2001; Tabbers et al., 2004). However, no studies exist on the modality effect in a workplace setting.

The modality effect was determined by a Welch two sample t test. Statistical significance was determined by \( p \leq 0.05 \) (Fisher, 1925) and practical significance by \( d \geq 0.50 \) (Cohen, 1988). The tests results statistically and practically supported Hypothesis 1 (\( t[303] = 6.40, p < 0.01, d = 0.73 \)). The group that received the Microsoft Teams lesson in an audio-visual mode (\( n_{T1-tmt} = 162, M = 5.59, SD = 2.25 \)) outperformed the group that received the same lesson in a visual-only mode (\( n_{T1-ctl} = 143, M = 4.04, SD = 1.94 \)) on the 10 question assessment taken immediately after viewing the learning material.

Based on the moderate effect size (\( d = 0.73 \)), the binomial effect size (treatment group = 67%, control group = 33%) indicated that the group that received the learning material in an audio-visual mode was 34% more successful than the group that received the same material in a visual-only mode (Reimer & Russell, 2017). This finding endorsed previous studies that found a statistical and practical significance of the modality effect in working memory (Mayer & Moreno, 1998; Moreno & Mayer, 1999). The current study's findings add to the literature on the modality effect in working memory by showing the modality effect in job-related training of U.S. adults who worked virtually due to COVID-19.
Long-Term Memory- Hypothesis 2

Hypothesis 2 reasoned that the modality effect would be evidenced in the treatment group when virtual workers were assessed one week after viewing a short training presentation in an audio-visual format. Although only one empirical study found statistically significant support but not practical support for the presence of the modality effect in long-term memory (Segers et al., 2008), Hypothesis 2 was assumed based on the evidence of the modality effect in working memory, and memory research. The literature suggested that information recalled after 30 seconds is likely stored in long-term memory (Baddeley, 2002; Ricker, 2015; Shiffrin & Atkinson, 1969).

The group that received the learning material in an audio-visual mode ($n_{T2-tmt} = 122, M = 4.56, SD = 1.93$) slightly outperformed the group that received the same learning material in a visual-only mode ($n_{T2-tmt} = 99, M = 4.17, SD = 1.51$). However, the tests results were not statistically nor practically significant ($t[219] = 1.70, p = 0.10, d = 0.22$). Based on the small effect sized ($d = 0.22$), the binomial effect size (treatment group = 56%, control group = 44%) indicated that the group that received the learning material in an audio-visual mode was 12% more successful than the group that received the same material in a visual-only mode (Reimer & Russell, 2017). The results of Hypothesis 2 is congruent with the findings of Witteman and Segers (2009). They did not find evidence of the modality effect when children were tested one week after a lesson about the weather. The findings of Hypothesis 2 added to the literature by suggesting that workplace training in the form of an audio-video presentation viewed once may not be conducive for long-term memory recall.
Implications

This section discusses the implications of the study. The implications are organized into three sections, implications to research, business practices, and theory.

Implications for Research

This study has implications for the HRD, Baddeley’s working memory, and modality effect research. This study makes two significant contributions to HRD research. The call for an investigation of online learning (Reio, 2015) was partially addressed. With social distancing in effect for the foreseeable future, online learning is the new normal (Cahapay, 2020; Yusoff et al., 2020). As such, it is now more critical than ever that HRD practitioners understand how to deliver the most effective virtual learning. Welsh, Wanberg, Brown, and Simmering (2003) agreed, “our review of the academic research on e-learning revealed the use of e-learning moving faster than our empirical understanding of e-learning (p. 256). The current study contributes to the HRD research by providing an unconventional research method to test the most effective mode of delivery when training virtual workers. The findings move the literature forward by providing evidence of the modality effect in a practical setting. DeRouin et al. (2004) noted that “because workplace e-learners have different needs and motivations than other types of learners, learner-controlled training may need to be designed differently in order to be successful” (p. 149). The current study contributes to research by providing evidence that the modality used in online learning has an effect on the memory recall of the learning material. This finding is significant to the HRD research to guide practitioners as they transition from traditional instruction to virtual. Scholars agree that to move forward, HRD scholars and practitioners must take risks and push boundaries.
(Bennett, 2009; Mancuso, Chlup, & McWhorter, 2010). This involves being more involved in technology development and embracing instructional design (Fagan, 2014; Mutamba, 2017). Another contribution to the HRD research is the response to the call to apply theory from other disciplines to educational context to understand better how technology “may or may not work as a learning and development tool” (Reio, 2015, p. 1). The current study applied theory from psychology and instructional technology in an HRD context. Baddeley’s working memory model informs HRD practitioners how information gained visually and aurally is processed and stored. This is significant to the HRD research because understanding the role the human senses play in memory can help practitioners design the most effective learning and development interventions.

This study makes two contributes to Baddeley’s working memory literature. First, the current study tested working and long-term memory in a practical setting. Baddeley’s experimental research tested subjects’ ability to recall lists of words, sentences, and numbers. The current study makes a prominent contribution to research by applying Baddeley’s working memory model in a practical setting. In this study, participants were provided with a short tutorial on the basic functionality of Microsoft Teams either in an audio-visual mode or a visual-only mode. They were then assessed on their ability to recall how to perform 10 basic functions in Microsoft Teams. The ability for subjects to apply learned material is more critical to HRD than memorizing items. Second, Baddeley’s research focused on individuals with memory disorders such as Alzheimer’s and dementia. These are not conditions that are prevalent in the workforce. As such, the current study contributes to HRD research by applying Baddeley’s working...
memory model to the study of employed individuals who self-reported no memory problems.

The current study advances the modality effect literature by evidencing the modality effect in working adults in a practical context. Until now, studies that evidenced the modality effect tested subjects in institutional, educational settings. Consequently, this makes a meaningful contribution to the modality effect research by introducing the modality effect to the HRD literature. This study adds to the existing literature that evidenced the modality effect when a posttest was administered immediately after the intervention (Mayer et al., 2003; Mayer & Moreno, 1998; Moreno & Mayer, 1999; Moreno et al., 2001; Tabbers et al., 2004). Alternatively, this study adds to the literature that did not evidence the modality effect when a posttest was administered one week after the intervention (Engle & Mobley, 1976; Witteman & Segers, 2009).

**Implications for Practice**

Instructional technology in HRD has been studied since the 1940s (Rosenberg, 1982). While online learning is not new, the consequences of the COVID-19 pandemic, many organizations were compelled to move their daily operations to a virtual environment. Given this, the current study has implications for HRD, education, instructional technology, and psychology.

Callahan (2010) stressed that HRD practitioners had leapt blindly into virtual training without “considering the implications of online learning” (p. 869). The current study is significant to HRD and VHRD practitioners by providing insight regarding instructional delivery mode for virtual training. This study provided statistical and
practical support for the modality effect in working memory. The study found that the group that received learning material in an audio-visual mode was 34% more successful than the group that received the learning material in text-only mode. Based on the finding of this study, organizations could benefit from incorporating audio-visual technology into virtual career development interventions. Advances in technology have made the development of audio-visual lessons straightforward. For example, lessons can be produced using a smartphone, an annotated PowerPoint, or snipping tool. Then, lessons can be uploaded to the company intranet, cloud storage, or YouTube. This finding is significant to the practice of HRD because it answered the question of the better delivery mode for virtual training and development using resources that many organizations already have access to.

The current study makes two significant contributions to the field of higher education. First, the COVID-19 pandemic forced educational institutions to go virtual. Months into the pandemic, many educators continued to struggle to master the tasks associated with online teaching (König, Jäger-Biela, & Glutsch, 2020). The current study informs educators on adult learning outcomes based on modality. Until now, much of what was known about the modality effect was studied in children (Jeung et al., 1997; Kalyuga et al., 1999; Leahy et al., 2003; Levin & Devine-Hawkins, 1974; Mann et al., 2002). Second, the experimental results provide compelling support for the use of technology in virtual training environments. This finding has significant implications for educators because decisions such as “using educational technology for teaching and learning in higher education” are based on “evidence and scientifically based research” (Holland & Escueta, 2020, p. 163).
The current study has three significant implications for the practice of instructional technology. First, Oh and Huang (2018) proposed that "scholarly activities ought to focus more on the 'design' and 'testing' of technological applications, tools, and artifacts, and their implementation and integration into the workplace for improving individual learning and organization performance" (p. 272). This study addressed Oh and Huang’s proposal by testing modality in the context of workplace learning. As illustrated in Table 1, recent empirical studies of online learning modality are confined to educational institution settings. This study provides evidence that is relevant to organizational learning. Second, this study contributes to the debate about the most effective instructional technology approaches (Atkinson, 2002; Crooks et al., 2012; Pellas, 2018) by providing evidence of the modality effect in working memory recall.

Lastly, the study makes three meaningful contributions to the field of psychology. First, this study provided support for the role the human senses play in memory in the context of learning and development interventions by testing memory recall of information received aurally and visually compared to information received visually-only. The findings of this study are congruent with Baddeley’s theory of the phonological loop and visuospatial sketchpad. Second, the current study contributed to the field of psychology by providing empirical memory recall research of subjects who self-reported no memory deficits. This is significant because Baddeley’s research was concentrated on subjects with mental disabilities. Third, this study contributes to the "investigation of the career implications of the COVID-19" (Guan, Deng, & Zhou, 2020, para. 1) by providing research on the modality effect in online employee learning of individuals who were forced into virtual workspaces due to the pandemic.
Limitations

There were four limitations associated with the present study. First, there was the possibility that the collected sample was not wholly representative of the desired population. However, care was taken to conduct a rigorous and generalizable study by executing a methodical survey design as detailed in the survey design section of this paper. In light of the limitation, comparing the sample's demographic variables to the U.S. Census Bureau (2019) and BLS (2020a, 2020b), demographic information should be taken into consideration.

Second, this study focused on U.S. employees working from home due to the COVID-19 pandemic and self-report no memory issues. As such, this study's findings may not be generalizable to nonvirtual employees or employees who have worked virtually for more than six months. Sixteen percent of the participants who responded to the prescreening survey were eliminated because they self-reported a memory deficit. Practitioners should consider this segment of the population when generalizing the findings to employees.

Third, the intervention was limited to a two and one-half minute training session. This is a substantial limitation to consider when interpreting the findings of this study because there is no evidence that the modality effect is present in long lessons (Crooks et al., 2012; Inan et al., 2015; Schüeler et al.; 2008; van den Broek et al., 2014).

Fourth, the current study used a posttest study design. The participants were not pretested to assess their comprehension of Microsoft Teams and relied on the survey taker’s self-reported lack of knowledge. In light of this, some participants could have had some knowledge of Microsoft Teams, which could have biased the test results.
Suggestions for Future Research

The study generated at least four recommendations for future research. First, the study could be replicated to evaluate the modality effect's presence with a more extensive training session. The current study tested memory recall of a tutorial that was only two and one-half minutes. Research should be conducted with learning material more relevant to the practice of HRD.

Second, the study could be replicated with all employees' inclusion to allow for generalizability beyond the current study. The current study tested the modality effect with a sample of employees working virtually due to COVID-19. Research to test memory recall and the modality effect with employees who have been working virtually for more than six months, and employees who do not work virtually would inform the practice of HRD.

Third, the study could be replicated and statistically analyzed within-subjects. The current study compared the mean scores between groups. An analysis to compare the mean scores between T1 and T2 for each group would inform practitioners and provide insight into the lack of support for the modality effect in long-term memory recall. The study would benefit from the inclusion of a pretest.

Fourth, the study could be replicated with only one group. Participants could receive both audio-visual and visual-only learning material at different times. An analysis within-subjects comparing the scores between audio-visual and visual-only material would further inform practitioners of the most effective virtual learning modality. This study would inform the visual-only group's current paradox of retaining more information learned than the audio-visual group. An analysis within-subjects would
inform the researcher if this phenomenon resulted from modality or if it was a consequence of the sample.

Chapter Summary

This chapter was organized into five sections. The results from Chapter 4 and relevant literature was discussed in section one. Then, implications to theory, research, and the fields of HRD and VHRD, higher education, instructional technology, and psychology practitioners was considered in the second section. The third section highlighted the limitations of the study. Lastly, suggestions for future research were provided in section four.


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https://doi.org/10.1348/000709904322848824


https://doi.org/10.1037/1076-898X.3.4.257


Appendix A: Examples

Audio-Visual Example

Visualize that an HRD practitioner is introducing employees to Microsoft Outlook calendar. The learner would see the following pictures (see Figure H1) while listening to the instructor say:

In Calendar, you will select New Appointment. Then, add a Subject, Location, and the start and end times. Next, select Invite Attendees to turn the appointment into a meeting. Select Save & Close to finish, or if it's a meeting, hit Send to notify the invitees.

![Image of Microsoft Outlook Calendar]

*Figure H1.* Steps to schedule a meeting in Microsoft Outlook Calendar. Adapted from “Manage your calendar and contacts in Outlook,” by *Microsoft Office*, 2020.
Appendix A (Continued)

Visual-Only Example

The learner would see the illustration in Figure H1 accompanied with text instructions:

1. In Calendar, select New Appointment.
2. Add a Subject, Location, and the start and end times.
3. Select Invite Attendees to turn the appointment into a meeting.
4. Select Save & Close to finish or Send if it's a meeting.

Visuospatial Example

An example of visual information may be that a person saw a red car or that a person saw a headline that read, "the car was red." Spatial data may be acquired by riding in an Uber in an unfamiliar area and observing the landscape, landmarks, and route.
Appendix B: Permission to Use Figures

Rights Summary

Annual Review of Psychology
Publication Type: Journal
ISSN: 0066-4308
Date: 1949 - Present
Publisher: Annual Reviews

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Current Biology
Publication Type: e-Journal
ISSN: 1879-0445
Date: 1990 - Present
Publisher: Elsevier Science

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- Printing copies and/or sharing with co-workers

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Appendix B (Continued)

AV communication review

Publication Type: Journal
ISSN: 0001-2890
Date: 1963 - 1976
Publisher: ASSOCIATION FOR EDUCATIONAL COMMUNICATIONS AND TEC

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- Post in a course management system
- Post in an academic institution intranet
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- Display in a presentation within your institution
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- Photocopy for classroom handouts
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### Appendix C: Power Analysis Using R

### determine sample size per group needed for a medium effect size

```r
> pwr.t.test(d=0.50, power=0.90, sig.level=0.05, type="two.sample", alternative="greater")
```

Two-sample t test power calculation

- **n = 69.19784**
- **d = 0.5**
- **sig.level = 0.05**
- **power = 0.9**
- **alternative = greater**

NOTE: n is number in *each* group
Appendix D: Pilot Study

Purpose of the Pilot Study

There were two purposes of this pilot study. First, the feasibility of the proposed experimental methods for data collection using Mturk® to test the research hypotheses was tested (Kim, 2017; Rutherford-Hemming, 2018).

Hypothesis 1: Virtual workers who receive material in an audio-visual format will have better working memory recall than virtual workers who receive material in a visual-only format as measured by a posttest assessment of Microsoft Teams functionality knowledge.

Hypothesis 2: Virtual workers who receive material in an audio-visual format will have better long-term memory recall than virtual workers who receive material in a visual-only format as measured by a one-week posttest assessment of Microsoft Teams functionality knowledge.

Second, the overall ability for the test items to measure participant performance was assessed. To test the research hypotheses, audio-visual represents information that is presented aurally and accompanied by illustrations such as a picture, graph, or drawing. Visual-only represents information that is presented in printed text accompanied by an illustration. As advised by Rutherford-Hemming (2018), this pilot study is not meant to test the hypothesis of the main study. This pilot study should be considered a trial run to identify any potential problems, and processes to correct them, before launching the
experiment on a large scale. In particular, the researcher is interested in testing the audio technology essential to the verbal instruction intervention for this study.

As detailed in the main study, a posttest-only between-subjects design was performed to test the research hypotheses, and surveys were generated using Qualtrics®. Participants were recruited via the HITS (human intelligence tasks) page on MTurk®. Workers had to pass a Captcha and consent to the survey before proceeding with the questions. Anonymity was endorsed, and participants could opt-out at any point. Data from each collection point were matched using the MTurk® WorkerID.

**Population**

The desired population and the sample frame were the same as those detailed in the main study.

**Sample**

The sample consisted of 56 MTurkers based in the U.S. and worked virtually, reported no familiarity with Microsoft Teams, no memory reading, or attention deficits. Based on the recommendation of Kim (2017), the desired sample size for the pilot study was 60 surveys. Four chi-square tests were performed to compare the population demographic percentages (gender, age, educational attainment, and occupation) to the percentages of the same demographics collected for the sample (Parke, 2013). If the chi-square yields a $p < 0.05$, the sample is statistically different from the population (Knapp, 2018). Practical significance was assessed by Cramèr’s $V$. $V = 0.39 – 0.50$ indicates a moderate correlation (McHugh, 2018). For the study, the desire is for the sample not to be different from the population. As such, the desired outcome of the Chi-square tests is
Appendix D (Continued)

$p > 0.05; V < 0.39$. As depicted in Table B1, the sample is representative of the population for gender and educational attainment. Age and occupation were not significantly representative of the population.
Appendix D (Continued)

Table D1
*Population and Sample Demographics for Pilot Study (n = 56)*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Population</th>
<th>Total Sample</th>
<th>Treatment Group</th>
<th>Control Group</th>
<th>(\chi^2)</th>
<th>(df)</th>
<th>(p)-value</th>
<th>Cramèr’s V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>52%</td>
<td>53%</td>
<td>59%</td>
<td>48%</td>
<td>0.10</td>
<td>1</td>
<td>0.90</td>
<td>0.04</td>
</tr>
<tr>
<td>Women</td>
<td>48%</td>
<td>47%</td>
<td>41%</td>
<td>52%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>42.00</td>
<td>2</td>
<td>&lt; 0.05</td>
<td>0.89</td>
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<tr>
<td>18-29</td>
<td>21%</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30-49</td>
<td>33%</td>
<td>30%</td>
<td>37%</td>
<td>24%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50+</td>
<td>46%</td>
<td>15%</td>
<td>08%</td>
<td>21%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race</td>
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<td></td>
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<tr>
<td>Caucasian</td>
<td>67%</td>
<td>76%</td>
<td>88%</td>
<td>66%</td>
<td>4.00</td>
<td>1</td>
<td>&lt; 0.05</td>
<td>0.20</td>
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<tr>
<td>Other</td>
<td>33%</td>
<td>24%</td>
<td>12%</td>
<td>34%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
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<td></td>
<td>0.60</td>
<td>1</td>
<td>0.50</td>
<td>0.10</td>
</tr>
<tr>
<td>High School or less</td>
<td>32%</td>
<td>27%</td>
<td>51%</td>
<td>83%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>College education</td>
<td>68%</td>
<td>73%</td>
<td>49%</td>
<td>17%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.09</td>
<td>1</td>
<td>0.80</td>
<td>0.04</td>
</tr>
<tr>
<td>Professional</td>
<td>62%</td>
<td>59%</td>
<td>52%</td>
<td>65%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>38%</td>
<td>41%</td>
<td>48%</td>
<td>35%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Data were taken from T2. Sample \(n = 56\), \(\chi^2\) = Chi-square comparing population to total sample; \(df\) = degrees of freedom. Test statistics compare population to total sample. Population gender from U.S. Census Bureau (2019). Population age and education data from the BLS (2020a). Population occupation data from the BLS (2020b).
Appendix D (Continued)

Materials, Stimuli, and Measurement

The pilot study followed the materials, stimuli, and measurement procedures detailed in the main study.

Survey Design

The survey design in the Pilot study is a replication of the survey design outlined in the main study. The surveys can be reviewed in Appendices P, Q, R and S.

Data Collection

Participation in this study was voluntary, and as such, the only permission requested was that of the Institutional Review Board (IRB) of The University of Texas at Tyler (see Appendix N). All data were collected digitally using Qualtrics™. HITS were launched on MTurk®. Upon accepting the HIT, workers were directed to the Qualtrics™ survey (see Appendix T).

Prescreening

A HIT with the title “Two-minute survey about you” was launched on April 12, 2020. The description read, “answer 12 short questions about yourself.” All participants that accepted the HIT were compensated 25 cents. The HIT closed on April 13, 2020, and 73 surveys were collected through Qualtrics™.

Intervention and Working Memory Test

The working memory test is detailed in the main study. Thirty-six participants were identified to participate in the experiment. Using the R® package randomizr, subjects were randomly assigned to the treatment group or the control group.
Qualifications were set in MTurk® to identify participants of each group. The R package, pyMTurkR was used to send an email invitation to the intervention to each of the 36 participants. Two HITs were created in MTurk® with the title, “Follow-up Survey.” The description for the control group read, “Review lesson material for two and a half minutes, then answer 30 multiple-choice questions.” The description for the treatment group read, “Watch a 2 1/2-minute video and answer 30 multiple-choice questions.” Qualtrics® estimated that it would take eight minutes to complete the survey. Based on the suggested 12 cents per minute, participants were offered $1.00 for participation (Chambers & Nimon, 2018). An email with the subject line, “Complete a follow-up survey for $0.60,” read, “Thanks for completing my HIT! Please complete my follow-up HIT ~ 8 minutes. The survey can be completed at [hyperlink].” The email was sent to the participants on Monday, April 13, 2020. Two reminder emails were sent. The intervention concluded on Monday, April 20, 2020, and the data were collected. After statistical analyses were performed on 29 surveys that were returned, it became apparent that to inform the main study additional data would need to be collected. The prescreening and intervention survey procedures were repeated to collect an additional 71 subjects eligible to participate in the study. Ninety-nine subjects returned the T1 survey.

**T2 and Long-Term Memory Test**

To assess long-term memory, and to test the measurement items, a follow-up survey consisting of the new 10-item measurement was sent one-week later to 99 qualified participants. The details of test development are detailed in the main study. Two HITs were created in MTurk® titled, “Follow-Up Survey ~ 2 Minutes,” with a
Appendix D (Continued)

description that read, “Answer 10 multiple-choice questions about Microsoft Teams.” Participants were offered 50 cents for their time. An email invitation was sent to qualified participants on April 26, 2020. The subject line read, “Bonus Opportunity.” The email read, "Thanks for completing my HIT! Answer 10 multiple-choice questions. The HIT can be found under your qualifications or search HITS for Gaby Lambert.” Due to complications with the links in T1, the link to the survey was not included in the email. A reminder email was sent to non-respondents each day. The retention rate from T1 to T2 was 72%, with 71 of the 99 eligible participating.

Data Analysis

The data analysis process involved a series of procedures. First, the data were cleaned, and then group equivalency was assessed. Statistical assumptions were tested, followed by testing the hypothesis. These steps are detailed in the following sections.

Data Cleaning

After data were collected for the five surveys in the three study phases, it was downloaded from Qualtrics™ and saved in CSV files. The data were uploaded into R® where it was cleaned by removing participants who did not pass the Captcha, did not consent, or did not complete the survey.

Prescreening. Of the 277 prescreening surveys, no cases were eliminated for failing the Captcha, not providing consent, nor for being incomplete (Oppenheimer et al., 2009; Rouse, 2015). One hundred fifty-six were disqualified because they reported having experience with Microsoft Teams. An additional four were removed for reporting a traumatic brain injury which interferes with their memory, and three self-assessed as
ADHD. Of those who completed the prescreening survey, 39% qualified to participate in the study.

**Intervention and T1 Survey.** The response to the intervention survey was 93%, with 99 of the 107 completing the T1 survey. Data were collected and analyzed. No surveys were eliminated during cleaning.

**T2 Survey.** Seventy-two percent of the eligible participants returned the T2 survey. No cases were eliminated during cleaning.

**Descriptive Statistics**

Descriptive statistics were computed using R® and reported in Table B2. Statistical significance, $p < 0.05$; practical significance, $d > 0.50$; the symmetry of the data, skewness, $+3$ to $-3$; and the peakedness of the data, kurtosis, $-2$, (Cameron, 2004; Taylor, 2008).

Table D2

*Descriptive Statistics for Pilot Study Groups*

<table>
<thead>
<tr>
<th>Group</th>
<th>Working Memory</th>
<th></th>
<th></th>
<th></th>
<th>Long-Term Memory</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$N$</td>
<td>Mean</td>
<td>$SD$</td>
<td>Skew</td>
<td>$\beta_2$</td>
<td>$n$</td>
<td>Mean</td>
<td>$SD$</td>
</tr>
<tr>
<td>Treatment</td>
<td>51</td>
<td>5.50</td>
<td>1.60</td>
<td>-0.29</td>
<td>-0.73</td>
<td>28</td>
<td>5.14</td>
<td>1.30</td>
</tr>
<tr>
<td>Control</td>
<td>48</td>
<td>3.70</td>
<td>1.40</td>
<td>-0.62</td>
<td>-0.62</td>
<td>28</td>
<td>4.19</td>
<td>1.42</td>
</tr>
</tbody>
</table>

*Note.* $SD =$ standard deviation, $\beta_2 =$ kurtosis.
Chi-Square Tests

Chi-square tests informed how well the sample generalized to the population (Parke, 2013). Four chi-square tests were computed to compare the population demographic percentages (gender, age, educational attainment, and occupation) to the percentages of the same demographics collected for the sample (see Table A2). Chi-square $p > 0.05$ indicates that the sample is not statistically different from the population (Knapp, 2018). Cramèr’s $V$ of 0.39 – 0.50 indicates a moderate correlation (McHugh, 2018).

Statistical Assumptions

All statistical measures have steadfast assumptions that must be complied with for the purpose of asserting that test results are valid. There were four assumptions of the $t$ test; (1) normal distribution, (2) interval level data, (3) scores are independent, and (4) homogeneity of variance, which were detailed in the main study (Field et al., 2012).

$t$ Tests

Independent-samples $t$-tests were conducted to test the modality effect in working memory (T1) and long-term memory (T2). Although subjects answered 30 questions in T1, statistics were run on the 10 questions that were identified for the measurement. Lavene’s test indicated that there was equal variance across groups $F (1, 97) = 0.69$, $p = 0.41$. There was a significant modality effect; audio-visual ($M = 5.50$, $SD = 1.60$) and visual-only ($M= 3.70$, $SD = 1.40$), $t (97) = 6.00$, $p < 0.01$, 95% CI = -1.24 – 2.4, $d = 1.20$, CI = 0.79 – 1.66. Hypothesis 1 was supported. Lavene’s test indicated equal variance across groups for T2 $F (1, 54) = 0.01$, $p = 0.92$. The modality effect was also
Appendix D (Continued)

significant in T2; audio-visual ($M = 5.1, SD = 1.30$) and visual-only ($M = 4.19, SD = 1.42$), $t (53) = 3, p = 0.01$. The data provided evidence for support of Hypothesis 2.

Internal and External Validity

The internal and external validity is thoroughly discussed in the main study.

Limitations

Three study limitations should be taken into consideration. First, there are limitations to using MTurk® for the recruitment of participants. Given that the experiment was performed online, there was ambiguity about the exact identity of the subjects (Horton et al., 2011). Also, some MTurkers use an online discussion board where they discuss the content of tasks they have completed or share HITs that they found interesting (White, Strezhnev, Lucas, Kruszewska, & Huff, 2018). Should such a discussion occur, it could affect the outcome of the current study. Individuals who choose to be MTurk® workers represent a small sample of the population; as such, the sample was not completely generalizable to the desired population. Second, since three participants in T2 completed T1 later than the majority of the sample, their measurement on long-term memory was assessed before a week had passed. Third, there were some challenges with the survey links in the prescreening and T1 surveys, which eliminated qualified participants.
Appendix E: Stimuli

**Treatment Group Audio-Visual Apparatus**

*Video Transcript for Video Lesson [https://youtu.be/jugBQqE_2sM](https://youtu.be/jugBQqE_2sM)*

<table>
<thead>
<tr>
<th>Time</th>
<th>Transcript</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:05</td>
<td>Hi, there! Welcome to Microsoft Teams, a collaboration app that helps your team stay organized and have conversations, all in one place. Let's start with what else? Teams!</td>
</tr>
<tr>
<td>00:13</td>
<td>Here you can see a list of all the teams you're part of. Teams are made up of channels. You can build them by topic, department, or just for fun.</td>
</tr>
<tr>
<td>00:25</td>
<td>Channels are where the real work gets done where you hold meetings, have team conversations, and share files.</td>
</tr>
<tr>
<td>00:34</td>
<td>At the top of each channel, you'll find tabs. They're like links to your favorite files, apps, and services.</td>
</tr>
<tr>
<td>00:42</td>
<td>Want to have a quick, on-the-spot meeting with people in your channel? Select Meet now. In a meeting, you can show content from your computer, or record your meeting.</td>
</tr>
<tr>
<td>00:54</td>
<td>When you share a file in a channel conversation, you and your team can edit it at the same time, and share thoughts alongside it.</td>
</tr>
<tr>
<td>01:03</td>
<td>To find all the files that have been shared in a channel, go to the Files tab at the top of the channel.</td>
</tr>
<tr>
<td>01:10</td>
<td>To see all the files ever shared across the team, click Files on the left.</td>
</tr>
<tr>
<td>01:15</td>
<td>Want to talk privately with a person or group? Click New chat at the top and type their names. Give the chat a name to make it easier to find later.</td>
</tr>
<tr>
<td>01:29</td>
<td>To make a call directly from a chat, click Video call or Audio call.</td>
</tr>
<tr>
<td>01:35</td>
<td>In some cases, if your organization has set it up, you can call anyone from Teams using Calls, even if they're not using Teams.</td>
</tr>
<tr>
<td>01:45</td>
<td>In Meetings, you can see everything you've got lined up for the day or week. Or, schedule a meeting. This calendar syncs with your Outlook calendar.</td>
</tr>
</tbody>
</table>
Appendix E (Continued)

Video Transcript (Continued)

<table>
<thead>
<tr>
<th>Time</th>
<th>Transcript</th>
</tr>
</thead>
<tbody>
<tr>
<td>01:57</td>
<td>Go to Activity for a view that lets you catch up on all your unread messages, @mentions, replies, and more.</td>
</tr>
<tr>
<td>02:04</td>
<td>And, use the Command box to search for specific items or people, take quick actions, and launch apps. Convenient, right?</td>
</tr>
<tr>
<td>02:14</td>
<td>And don't forget to download the mobile app, so you're in sync when you're on the go.</td>
</tr>
<tr>
<td>02:20</td>
<td>Thanks for watching. Now bring in your team and let the collaboration begin!</td>
</tr>
</tbody>
</table>

Control Group Visual-Only Apparatus
Appendix E (Continued)

Microsoft Teams

Sign in

In Windows, click start > Microsoft Teams.
On Mac, go to the Applications folder and click Microsoft Teams.
On mobile, tap the Teams icon. Then sign in with your Microsoft 365 username and password. (If you're using Teams free, sign in with that username and password.)

Pick a team and channel

A team is a collection of people, conversations, files, and tools—all in one place.
A channel is a discussion in a team, dedicated to a department, project, or topic.
Select Teams and choose a team. Pick a channel to explore Posts, Files, and other tabs.

Start a conversation

With the whole team... Select Teams, pick a team and channel, write your message, and click Send.

With a person or group... Click New chat, type the name of the person or group in the To field, write your message, and click Send.

Start an impromptu meeting

Click Meet now. Under the area where you type a message to start a meeting in a channel. (If you click Reply, then Meet now, the meeting is based on that conversation.) Enter a name for the meeting, then start inviting people.

Note. Numbers inside the purple dashed box indicate the time in the video where the topic is discussed. The “X” represents material in the visual-only presentation that is not in the audio-visual presentation.
Note. Numbers inside the purple dashed box indicate the time in the video where the topic is discussed. The “X” represents material in the visual-only presentation that is not in the audio-visual presentation.
Appendix E (Continued)

Microsoft Teams

Stay on top of things @ 1:57
Click Activity 📢 on the left. The Feed shows you all your notifications and everything that’s happened lately in the channels you follow. To set up notifications for a channel, choose ⋮ next to the channel name, then Channel notifications.

Share a file @ 0:54
Click Attach 📐 under the box where you type messages, select the file location and then the file you want. Depending on the location of the file, you’ll get options for uploading a copy, sharing a link, or other ways to share.

Add a tab in a channel @ 0:34
Click + by the tabs at the top of the channel, click the app you want, and then follow the prompts. Use Search if you don’t see the app you want.

Work with files @ 1:05
Click Files 📁 on the left to see all files shared across all of your teams. Click Files 📁 at the top of a channel to see all files shared in that channel. Click More options ⋮ next to a file to see what you can do with it. In a channel, you can instantly turn a file into a tab at the top!

*Note.* Numbers inside purple dashed box indicate the time in the video where the topic is discussed.
Note. Adapted from “Microsoft Teams quick start guide,” by Microsoft, 2020. Numbers inside the purple dashed box indicate the time in the video where the topic is discussed. The “X” represents material in the visual-only presentation that is not in the audio-visual presentation.
Appendix F: Expert Panel

_Cyndi Butler_ is a Business Development Representative for SMA Technologies. Her role is to help clients improve business efficiencies by taking away the manual processes so that they can focus their attention on high-value projects. Cyndi has used Microsoft Teams for a year to streamline projects.

_Jennifer Carnahan_ is the Career Development and Education Manager at NRT, where she has worked for six years. Jennifer is responsible for training and continuing education of over 50,000 real estate associates. She began using Microsoft Teams to communicate and meet with associates when she could not meet with them face-to-face. Jennifer has trained hundreds of employees on Microsoft Teams.

_Kimberly Lalou_ is a Branch Manager for Coldwell Banker Realty in Spring, Texas. When the Harris County Judge ordered nonessential businesses to close, Kimberly began using Microsoft Teams to stay in contact with the 52 team members she manages. She has used Teams daily for four months to hold meetings, training, and social events.

_Chet Russell_ has been a Branch Manager at Coldwell Banker Realty in the Houston area for over 20 years. He is responsible for 46 team members in two locations. Chet has used Microsoft Teams for five months to stay in contact with his team that is spread out geographically.

_Mindy Welch_ is the Branch Manager for Coldwell Banker Realty in Brazoria County, Texas. Mindy manages 41 associates across a large geographic area along the Texas Gulf Coast. Mindy has relied on Microsoft Teams for several months to keep her team informed, host meetings, and to conduct professional coaching.
Appendix G: Microsoft Teams Working Memory Test (T1)

1. (Q2) To stay in sync with your team, ________. 
   - sync calendar with outlook
   - allow text notifications
   - set-up email notifications
   - download the mobile app

2. (Q8) At the top of each channel, you'll find ________ they are like links to your favorite files, apps, and services.
   - tabs
   - channels
   - activity
   - favorites

3. (Q11) You and your team can edit a document at the same time when the file is.
   - in files
   - in OneDrive
   - in SharePoint
   - in the channel conversation

4. (Q12) ________ is where the real work gets done.
   - meetings
   - files
   - channels
   - tabs

5. (Q13) To make a chat easy to find later, ________.
   - save it to files
   - tag it
   - move it to favorites
   - give it a name

6. (Q17) When you share a file in a channel conversation, you and your team can ________.
   - edit it one at a time
   - share thoughts alongside it
   - read-only
   - make anonymous suggestions

7. (Q20) To help your team stay organized and have conversations, all in one place, download ________.
   - channels
   - Microsoft mobile app
   - teams
   - OneDrive

8. (Q24) To see all the files shared across a channel, in the files menu, select ________.
   - documents
   - OneDrive
   - SharePoint
   - files

9. (Q27) To start a meeting select ________.
   - video call
   - meet now
   - join meeting
   - start a new meeting

10. (Q30) Teams are made-up of ________.
    - files
    - apps
    - channels
    - tabs
Appendix H: Microsoft Teams Long-Term Memory Test (T2)

1. To start a meeting click on ________.
   - meet now
   - video call
   - join meeting
   - start a new meeting

2. Teams are made-up of ________.
   - files
   - tabs
   - apps
   - channels

3. You and your team can edit a document at the same time when the file is ________.
   - in the channel conversation
   - in SharePoint
   - in files
   - In OneDrive

4. When you share a file in a channel conversation, you and your team can ________.
   - read-only
   - make anonymous
   - share thoughts
   - edit it one at a time
   - alongside it

5. To help your team stay organized and have conversations, all in one place, download ________.
   - Microsoft mobile app
   - OneDrive
   - teams
   - channels

6. To see all the files shared across a channel, in the files menu, select ________.
   - SharePoint
   - files
   - OneDrive
   - documents

7. At the top of each channel, you'll find ________ they are like links to your favorite files, apps, and services.
   - channels
   - tabs
   - activity
   - favorites

8. ________ is where the real work gets done.
   - channels
   - tabs
   - meetings
   - files

9. To stay in sync with your team, ________.
   - download the mobile app
   - set-up email
   - sync calendar with
   - allow text
   - notifications
   - Outlook
   - notifications

10. To make a chat easy to find later, ________.
    - tag it
    - save it to files
    - move it to favorites
    - give it a name
Appendix I: Prescreening Survey

https://uttyler.az1.qualtrics.com/jfe/form/SV_cP8hH25V46IGcgl
Appendix I (Continued)

THE UNIVERSITY OF TEXAS AT TYLER

Informed Consent (Online, Anonymous) to Participate in Research
IRB Review Board: FY2020-111
Approval Date: August 5, 2020

You have been asked to take part in this study to learn how Human Resource Development experts can improve career skills training. Taking this survey is your choice, and if you begin the survey and do not want to finish it, you can quit.

If you agree to be in this study, we will ask you to do three things:
1. Answer 13 yes/no and multiple-choice questions about yourself.
2. Answer the questions at one time.
3. Not discuss this survey with any other MTurkers including on discussion boards.

There are not any known risks to this study, other than becoming a little tired of reviewing the info. You are able to quit the survey at any time without harm. The results of this study could
• Improve career skills training.
• Make access to career skills training easier.

Your identity will not be known to anyone and your responses will not be linked to you in any future writings of the results. If you need to ask questions about this study, you can contact Dr. David Pearson, Chair of the UT Tyler Institutional Review Board at dpearson@uttyler.edu, or 903-565-5858.

I have read and understood what has been explained to me. If I choose to take part in this study, I will click “Yes” in the box below and carry on with the survey. If I choose not to take part, I will click “No” in the box.

☐ yes
☐ no
This is a pre-screening survey. Qualified respondents will be invited to participate in a follow-up survey. Please answer the following 7 yes/no questions about yourself. Remember, there are no right or wrong answers and your responses are anonymous.

Are you employed?
- Yes
- No

Are you currently working from home (your job is remote or you are working remote due to the COVID-19 pandemic)?
- Yes
- No

Do you now, or have you ever, use the computer program Microsoft Teams?
- Yes
- No

Have you experienced a traumatic brain injury that resulted in permanent memory impairment?
- Yes
- No

Do you suffer from Alzheimer's, Dementia, Korsakoff syndrome, or Parkinson's disease?
- Yes
- No

Do you self-identify with Attention Deficit Disorder (ADD) or Attention Deficit Hyperactivity Disorder (ADHD)?
- Yes
- No

Do you struggle with reading due to Dyslexia, Dysgraphia, or a reading disorder?
- Yes
- No
Appendix I (Continued)

Please answer the following 5 demographic questions about yourself. Your answers are confidential.

Please select the option that you best identify with

- Male
- Female

Please select the option that represents your age.

- 18-34
- 35-54
- 55+

Please select the option that most closely resembles your race/ethnicity.

- Asian
- Black
- Hispanic
- White
- Other

Please select the option that most closely represents your educational attainment.

- Did not graduate high school
- High school or equivalent
- Some college, but no degree
- Associate's degree
- Bachelor's degree
- Graduate degree
Appendix I (Continued)

Which of the following best describes your occupation?

- Management, professional, and related occupations (management; business and financial operations; computer and mathematical; architecture; engineering; life, physical, and social science; community and social service; legal; education, training, and library; arts, design, entertainment, sports, and media; healthcare practitioners and technical).
- Service occupations (healthcare support; protective service; food preparation and serving related; building maintenance and grounds cleaning; personal care and service)
- Sales and office occupations (sales and related, office and administrative support)
- Natural resources, construction, and maintenance (farming, fishing, and forestry; construction and extraction; installation, maintenance, and repair)
- Production, transportation, and material moving occupations
- Other

Your response has been recorded. Thank you for your time and participation. Please copy and paste the following code into the MTurk HIT to receive payment R_1cSxnnHDb6K9ODv
Appendix J: Treatment Group T1 Survey

https://utyler.az1.qualtrics.com/jfe/form/SV_cIOhb9YLFUuN5Ah
Appendix J (Continued)

THE UNIVERSITY OF TEXAS AT TYLER

Informed Consent (Online, Anonymous) to Participate in Research
IRB Review Board: FY2020-111
Approval Date: August 5, 2020

You have been asked to take part in this study to learn how Human Resource Development experts can improve career skills training. Taking this survey is your choice, and if you begin the survey and do not want to finish it, you can quit.

If you agree to be in this study, we will ask you to do four things:

1. Watch a 2 ½ minute video about Microsoft Teams
2. Answer 10 multiple-choice questions about the material covered in the video
3. Answer the questions from memory within five minutes
4. Not discuss this survey with any other MTurkers including on discussion boards.

There are not any known risks to this study, other than becoming a little tired of reviewing the info. You are able to quit the survey at any time without harm. The results of this study could:

* Improve career skills training
* Make access to career skills training easier

Your identity will not be known to anyone and your responses will not be linked to you in any future writings of the results. If you need to ask questions about this study, you can contact Dr. David Pearson, Chair of the UT Tyler Institutional Review Board at dpearson@uttyler.edu, or 903-565-5858.

I have read and understood what has been explained to me. If I choose to take part in this study, I will click “Yes” in the box below and carry on with the survey. If I choose not to take part, I will click “No” in the box.
Appendix J (Continued)

Video Link: https://youtu.be/jugBQqE_2sM

Please watch the short video below. Afterwards, you will be asked to answer 10 multiple-choice questions regarding the information presented in the film.
Appendix J (Continued)

You have five minutes to answer the following 10 questions. Your responses are very important to this research. Please, read every question and answer to the best of your ability from memory, without looking-up the answers. You will not be penalized for wrong answers and your survey is anonymous.

1. To stay in sync with your team, ___.
   - sync calendar with outlook
   - allow text notifications
   - set-up email notifications
   - download the mobile app

2. At the top of each channel, you’ll find _____ they are like links to your favorite files, apps, and services.
   - tabs
   - channels
   - activity
   - favorites

3. You and your team can edit a document at the same time when the file is ___.
   - in files
   - in OneDrive
   - in SharePoint
   - in the channel conversation

4. ___ is where the real work gets done.
   - meetings
   - files
   - channels
   - tabs
Appendix J (Continued)

5. To make a chat easy to find later, ____.
   - Save it to files
   - tag it
   - move it to favorites
   - give it a name

6. When you share a file in a channel conversation, you and your team can ____.
   - edit it one at a time
   - share thoughts alongside it
   - read-only
   - make anonymous suggestions

7. To help your team stay organized and have conversations, all in one place, download ____.
   - Channels
   - Microsoft mobile app
   - Teams
   - OneDrive

8. To see all the files shared across a channel, in the files menu, select ____.
   - SharePoint
   - OneDrive
   - documents
   - files

9. To start a meeting click on ____.
   - video call
   - join meeting
   - start a new meeting
   - meet now

10. Teams are made-up of ____.
    - tabs
    - files
    - channels
    - apps
Thank you for your time. Please copy and paste the following code into the MTurk® HIT to receive payment and bonus R_3QMGFAlRLA8W10R.
Appendix K: T1 Control Group Survey

https://uttyler.az1.qualtrics.com/jfe/form/SV_25InZYHF4MkHXaB
Appendix K (Continued)

THE UNIVERSITY OF TEXAS AT TYLER

Informed Consent (Online, Anonymous) to Participate in Research

IRB Review Board: FY2020-111
Approval Date: August 5, 2020

You have been asked to take part in this study to learn how Human Resource Development experts can improve career skills training. Taking this survey is your choice, and if you begin the survey and do not want to finish it, you can quit.

If you agree to be in this study, we will ask you to do four things:
1. Take two and a half minutes to review the document below.
2. Answer 10 multiple-choice questions.
3. Answer the questions at one time.
4. Not discuss this survey with any other MTurkers including on discussion boards.

There are not any known risks to this study, other than becoming a little tired of reviewing the info. You are able to quit the survey at any time without harm. The results of this study could
• Improve career skills training.
• Make access to career skills training easier.

Your identity will not be known to anyone and your responses will not be linked to you in any future writings of the results. If you need to ask questions about this study, you can contact Dr. David Pearson, Chair of the UT Tyler Institutional Review Board at dpearson@uttyler.edu, or 903-565-5858.

I have read and understood what has been explained to me. If I choose to take part in this study, I will click “Yes” in the box below and carry on with the survey. If I choose not to take part, I will click “No” in the box.

○ Yes
○ No
Appendix K (Continued)

Please take two and a half minutes to review the Microsoft Teams document below. You will be asked to answer 10 multiple-choice questions regarding the material.

Microsoft Teams

Sign in

To Windows, click Start - Microsoft Teams.

On Mac, go to the Applications folder and click Microsoft Teams.

On mobile, tap the Teams app. Then sign in with your Microsoft 365 username and password. If you’re using Teams free, sign in with that username and password.

Pick a team and channel

A team is a collection of people, conversations, files, and tasks—all in one place. A channel is a discussion in a team, dedicated to a department, project, or topic. Select Teams — and choose a team. Pick a channel to explore Posts, Files, and other tabs.

Start a conversation

With the whole team. Select Teams — then pick a team and channel, write your message, and click Send.

With a person or group. Click New chat — type the name of the person or group in the To field, write your message, and click Send.

Start an impromptu meeting

Click Meet now at the area where you type a message to start a meeting in a channel. If you click Reply, then Meet now, the meeting is based on that conversation. Enter a name for the meeting, then start inviting people.
Microsoft Teams

Make video and audio calls
Click Video call or Audio call, to call someone from a chat. To dial a number, click Calls, to view your call history and voicemail in the same area.

@mention someone
To get someone's attention, type @ then their name or pick them from the list that appears. Type @team to message everyone in a team or @channel to notify everyone who favored that channel.

Reply to a post
Channel posts are organized by date and then threaded. Find the thread you want to reply to, then click Reply. Add your thoughts and click Send.

Add an emoji, meme, or GIF
Click the GIF location and then type your message, click on the GIF. There are also buttons for adding an emoji or GIF.

Click to write the question text
Microsoft Teams

Stay on top of things
Click Activity on the left. The Feed shows you all your notifications and everything that's happened lately in the channels you follow. To set up notifications for a channel, choose ____ next to the channel name, then Channel notifications.

Add a tab in a channel
Click ____ by the tabs at the top of the channel, click the app you want, and then follow the prompts. Use Search if you don't see the app you want.

Share a file
Click Attach under the box where you type messages, select the file location and then the file you want. Depending on the location of the file, you will get options for uploading a copy, sharing a link, or other ways to share.

Work with files
Click Files in the left to see all files shared across all of your teams. Click Files at the top of a channel to see all files shared in that channel. Click More options next to a file to see what you can do with it. In a channel, you can instantly turn a file into a tab at the top.
Microsoft Teams

Search for stuff

Type a phrase in the command box at the top of the app and press Enter. Then select the Messages, People, or Files tab. Select an item or use the filters to refine your results.

Quick Start Guide

You will not be able to move to the next page until two and a half minutes have passed. When you are ready, please go to the next page to answer 10 multiple-choice questions about Microsoft Teams.
Appendix K (Continued)

You have five minutes to answer the following 10 questions. Your responses are very important to this research. Please, read every question and answer to the best of your ability from memory, without looking-up the answers. You will not be penalized for wrong answers and your survey is anonymous.

1. To stay in sync with your team, ___.
   - sync calendar with outlook
   - allow text notifications
   - set-up email notifications
   - download the mobile app

2. At the top of each channel, you'll find _____ they are like links to your favorite files, apps, and services.
   - tabs
   - channels
   - activity
   - favorites

3. You and your team can edit a document at the same time when the file is ___.
   - in files
   - in OneDrive
   - in SharePoint
   - in the channel conversation

4. ____ is where the real work gets done.
   - meetings
   - files
   - channels
   - tabs
Appendix K (Continued)

5. To make a chat easy to find later, ___.
   - Save it to files
   - tag it
   - move it to favorites
   - give it a name

6. When you share a file in a channel conversation, you and your team can ___.
   - edit it one at a time
   - share thoughts alongside it
   - read-only
   - make anonymous suggestions

7. To help your team stay organized and have conversations, all in one place, download ___.
   - Channels
   - Microsoft mobile app
   - Teams
   - OneDrive

8. To see all the files shared across a channel, in the files menu, select ___.
   - SharePoint
   - OneDrive
   - documents
   - files

9. To start a meeting click on ___.
   - video call
   - join meeting
   - start a new meeting
   - meet now

10. Teams are made-up of ___.
    - tabs
    - files
    - channels
    - apps
Thank you for your time. Please copy and paste the following code into the MTurk® HIT to receive payment and bonus R_3QMGFAiRLA8Wl0R.
Appendix L: Treatment and Control Group T2 Survey

Treatment Group:  https://uttyler.az1.qualtrics.com/jfe/form/SV_2b4fdZkNgsrF5Tn

Control Group:  https://uttyler.az1.qualtrics.com/jfe/form/SV_5zOXFytnZ6yzYJ7
Appendix L (Continued)

THE UNIVERSITY OF TEXAS AT TYLER

Informed Consent (Online, Anonymous) to Participate in Research
IRB Review Board: FY2020-111
Approval Date: August 5, 2020

You have been asked to take part in this study to learn how Human Resource Development experts can improve career skills training. Taking this survey is your choice, and if you begin the survey and do not want to finish it, you can quit.

If you agree to be in this study, we will ask you to do three things:
1. Complete 10 multiple-choice questions about the material you reviewed last week.
2. Answer the 10 questions at one time.
3. Not discuss this survey with any other MTurkers including on discussion boards.

There are not any known risks to this study, other than becoming a little tired of reviewing the info. You are able to quit the survey at any time without harm. The results of this study could
* Improve career skills training
* Make access to career skills training easier.

Your identity will not be known to anyone and your responses will not be linked to you in any future writings of the results. If you need to ask questions about this study, you can contact Dr. David Pearson, Chair of the UT Tyler Institutional Review Board at dpearson@uttyler.edu, or 903-565-5858.

I have read and understood what has been explained to me. If I choose to take part in this study, I will click “Yes” in the box below and carry on with the survey. If I choose not to take part, I will click “No” in the box.

☐ Yes
☐ No
Appendix L (Continued)

You recently reviewed some information regarding Microsoft Teams. Your responses are very important to this research. Please, read every question and answer to the best of your ability from memory, without looking-up the answers. You have five minutes to answer the following 10 questions. You will not be penalized for wrong answers and your survey is anonymous.

1. To start a meeting click on ___.
   - meet now
   - video call
   - join meeting
   - start a new meeting

2. Teams are made-up of ___.
   - files
   - tabs
   - apps
   - channels

3. You and your team can edit a document at the same time when the file is ___.
   - in the channel conversation
   - in SharePoint
   - in files
   - in OneDrive

4. When you share a file in a channel conversation, you and your team can ___.
   - read-only
   - make anonymous suggestions
   - share thoughts alongside it
   - edit it one at a time
Appendix L (Continued)

5. To make a chat easy to find later, ___.
   - Save it to files
   - tag it
   - move it to favorites
   - give it a name

6. When you share a file in a channel conversation, you and your team can ___.
   - edit it one at a time
   - share thoughts alongside it
   - read-only
   - make anonymous suggestions

7. To help your team stay organized and have conversations, all in one place, download ___.
   - Channels
   - Microsoft mobile app
   - Teams
   - OneDrive

8. To see all the files shared across a channel, in the files menu, select ___.
   - SharePoint
   - OneDrive
   - documents
   - files

9. To start a meeting click on ___.
   - video call
   - join meeting
   - start a new meeting
   - meet now

10. Teams are made-up of ___.
    - tabs
    - files
    - channels
    - apps
Thank you for your time. Please copy and paste the following code into the MTurk® HIT to receive payment and bonus R_1nVh3ox3pHsAP1.
Appendix M: MTurk® HITS

Prescreening Survey HIT

Project Name: Prescreening

Title: 
HITs hits HITs HITs HITs

Description: 
Answer 13 short questions about yourself.

Keywords: 
survey, demographics

Setting up your survey

Number of responses: 672

Number of respondents: 672

Time allotted per Worker: 1 hour

Survey expires in 7 days

Auto-approve and pay Workers if 1 day

Worker requirements

Require that Workers do their tasks (Prescreening HIT results)?

Mandatory additional qualifications: Workers must meet to work on your HIT:

test wave: has not been granted

Required qualifications: (see more)

This project may contain potentially explicit or offensive content, for example, nudity.

Task Visibility: (select one option)

Public: All Workers can see and preview my task

Private: All Workers can see my task, but only Workers that meet all qualification requirements can preview my task

HTTPS: Only Workers that meet my qualification requirements can see and preview my task
Appendix M (Continued)

Treatment Group T1 Survey HIT

<table>
<thead>
<tr>
<th>Edit Project</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project Name</strong>: Treatment</td>
</tr>
<tr>
<td><strong>Title</strong>: Follow-Up Survey</td>
</tr>
<tr>
<td><strong>Description</strong>: Watch a 2 1/2 minute video and answer 10 multiple-choice questions. Give more detail about the survey. This gives Workers a bit more information before they decide to view the survey.</td>
</tr>
<tr>
<td><strong>Keywords</strong>: survey, demographics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Setting up your survey</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reward per response</strong>: $1.00</td>
</tr>
<tr>
<td><strong>Number of respondents</strong>: 1</td>
</tr>
<tr>
<td><strong>Time allotted per Worker</strong>: 1 Hours</td>
</tr>
<tr>
<td><strong>Survey expires in</strong>: 6 Days</td>
</tr>
<tr>
<td><strong>Auto-approve and pay Workers in</strong>: 1 Days</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Worker requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Require that Workers be Masters to do your tasks</strong>: (Who are Mechanical Turk Masters?)</td>
</tr>
<tr>
<td><strong>specify any additional qualifications Workers must meet to work on your tasks</strong>: treatmentT1 equal to 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project contains adult content:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Task Visibility</strong>: (What is task visibility?)</td>
</tr>
<tr>
<td><strong>Public</strong>: All Workers can see and review your tasks</td>
</tr>
<tr>
<td><strong>Private</strong>: All Workers can see my tasks, but only Workers that meet all Qualification requirements can preview my tasks</td>
</tr>
<tr>
<td><strong>Hidden</strong>: Only Workers that meet my Qualification requirements can see and preview my tasks</td>
</tr>
</tbody>
</table>
Appendix M (Continued)

Control Group T1 Survey HIT

<table>
<thead>
<tr>
<th>Enter Properties</th>
<th>Design Layout</th>
<th>Preview and Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Name:</td>
<td>Control</td>
<td>This name is not displayed to Workers.</td>
</tr>
<tr>
<td>Describe your survey to Workers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Title</td>
<td>Follow-up Survey</td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>Review lesson material for two and a half minutes, then answer 10 multiple-choice questions</td>
<td></td>
</tr>
<tr>
<td>Give more detail about this survey. This gives Workers a bit more information before they decide to view your survey.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Keywords</td>
<td>survey_demographics</td>
<td></td>
</tr>
<tr>
<td>Setting up your survey</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reward per response</td>
<td>$ 5.5</td>
<td></td>
</tr>
<tr>
<td>This is how much a Worker will be paid for completing your survey. Consider how long it will take a Worker to complete your survey.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of respondents</td>
<td>317</td>
<td></td>
</tr>
<tr>
<td>How many unique Workers do you want to complete your survey?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time allotted per Worker</td>
<td>1 Hours</td>
<td></td>
</tr>
<tr>
<td>Maximum time a Worker has to complete the survey. Be generous so that Workers are not rushed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Survey expires in</td>
<td>5 Days</td>
<td></td>
</tr>
<tr>
<td>Maximum time your survey will be available to Workers on Mechanical Turk.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auto-approve and pay Workers in</td>
<td>1 Days</td>
<td></td>
</tr>
<tr>
<td>This is the amount of time you have to reject a Worker's assignment after they submit the assignment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worker requirements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Require that Workers be Masters to do your tasks (What are Mechanical Turk Masters)?</td>
<td>Yes ☐ No ☑</td>
<td></td>
</tr>
<tr>
<td>Specify any additional qualifications Workers must meet to work on your tasks:</td>
<td>control ☑ equal to ☑ 2 ☑</td>
<td></td>
</tr>
<tr>
<td>(up to 4 more)</td>
<td>Remove</td>
<td></td>
</tr>
<tr>
<td>Premium Qualifications incur additional fees, see Pricing Details to learn more.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project contains adult content (See details):</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>This project may contain potentially explicit or offensive content, for example, nudity.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task Visibility (What is task visibility?):</td>
<td>Public ☐ All Workers can see and preview my tasks</td>
<td></td>
</tr>
<tr>
<td>Private ☐ All Workers can see my tasks, but only Workers that meet all Qualification requirements can preview my tasks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hidden ☐ Only Workers that meet my Qualification requirements can see and preview my tasks</td>
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Appendix M (Continued)

Treatment Group T2 Survey HIT

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<tbody>
<tr>
<td><strong>Project Name:</strong> T2 Treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Describe your survey to Workers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Title:</strong> Follow-Up Survey – 2 Minutes</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Description:</strong> Answer 10 multiple-choice questions about Microsoft Teams</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Keywords:</strong> survey, demographics</td>
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### Setting up your survey

<table>
<thead>
<tr>
<th>Reward per response</th>
<th>$0.5</th>
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<tr>
<td>Number of respondents</td>
<td>228</td>
</tr>
<tr>
<td>Time allotted per Worker</td>
<td>1 Hour</td>
</tr>
<tr>
<td>Survey expires in</td>
<td>7 Days</td>
</tr>
<tr>
<td>Auto-approve and pay Workers in</td>
<td>3 Days</td>
</tr>
</tbody>
</table>

### Worker requirements

Require that Workers be Masters to do your tasks: (Are Mechanical Turk Masters?)
- Yes  □  No  □

Specify any additional qualifications Workers must meet to work on your tasks:
- First wave: equal to 0

This project may contain potentially explicit or offensive content, for example, nudity.

Task Visibility: (What is task visibility?)
- Public: All Workers can see and preview my tasks
- Private: All Workers can see my tasks, but only Workers that meet all Qualification requirements can preview my tasks
- Hidden: Only Workers that meet my Qualification requirements can see and preview my tasks
Appendix M (Continued)

Control Group T2 Survey HIT

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Project Name: T2 Control</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Describe your survey to Workers**

- **Title**: Follow-Up Survey - 2 Minutes
- **Description**: Answer 10 multiple-choice questions about Microsoft Teams
- **Keywords**: survey, demographics

**Setting up your survey**

- **Reward per response**: $0.5
- **Number of respondents**: 12
- **Time allotted per Worker**: 1 hour
- **Survey expires in**: 7 days
- **Auto-approve and pay Workers in**: 3 days

**Worker requirements**

- **Require that Workers be Masters to do your tasks?** Yes
- **Specify any additional qualifications Workers must meet to work on your tasks:**
  - first wave
  - equal to
  - 1

**Project contains adult content?**
- No

**Task Visibility**
- Public: All Workers can see and preview my tasks
- Private: All Workers can see my tasks, but only Workers that meet all Qualification requirements can preview my tasks
- Hidden: Only Workers that meet my Qualification requirements can see and preview my tasks
February 6, 2020

Dear Ms. Chretien,

Your request to conduct the study, *Microlearning, the Modality Effect, and Memory Recall: A Pilot Study of American Millennial Females in the Gig Economy*, IRB # Sp2020-09 has been approved by the University of Texas at Tyler Institutional Review Board as a study exempt from further IRB review, Category #2. While this approval includes a waiver of signed, written informed consent, please ensure prospective informed consent is provided unless special circumstances are indicated in the approval email. In addition, please ensure that any research assistants are knowledgeable about research ethics and confidentiality, and any co-investigators have completed human protection training within the past three years, and have forwarded their certificates to the Office of Research and Scholarship (research@uttyler.edu).

Please review the UT Tyler IRB Principal Investigator Responsibilities, and acknowledge your understanding of these responsibilities and the following through return of this email to the IRB Chair within one week after receipt of this approval letter:

- Prompt reporting to the UT Tyler IRB of any proposed changes to this research activity.
- Prompt reporting to the UT Tyler IRB and academic department administration will be done of any unanticipated problems involving risks to subjects or others.
- Suspension or termination of approval may be done if there is evidence of any serious or continuing noncompliance with Federal Regulations or any aberrations in original proposal.
- Any change in proposal procedures must be promptly reported to the IRB prior to implementing any changes except when necessary to eliminate apparent immediate hazards to the subject.
- Submit Progress Report when study is concluded.

Best of luck in your research, and do not hesitate to contact me if you need any further assistance.

Sincerely,

David Pearson, Ph.D.
Associate Professor
Department of Pharmaceutical Sciences
Ben and Maytee Fisch College of Pharmacy
Chair Institutional Review Board
Appendix O: IRB Approval for Main Study

IRB-FY2020-111  Testing the Modality Effect In an Online Training of Virtual Workers: A Longitudinal Experiment Inspired by Social Distancing

<table>
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<th>Approval Date:</th>
<th>Expiration Date:</th>
<th>Organization:</th>
<th>Active Submissions:</th>
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<tr>
<td>08-05-2020</td>
<td>N/A</td>
<td>Human Resource Dev &amp; Tech</td>
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<td>Admin Check-In Date:</td>
<td>Closed Date:</td>
<td>Current Policy</td>
<td>Sponsors:</td>
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<td>Post-2018 Rule</td>
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<table>
<thead>
<tr>
<th>Key Contacts:</th>
<th>Attachments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team Member</td>
<td>Role</td>
</tr>
<tr>
<td>Kim Nimon</td>
<td>Co-Principal Investigator</td>
</tr>
<tr>
<td>Janice Chretien</td>
<td>Principal Investigator</td>
</tr>
<tr>
<td>Janice Chretien</td>
<td>Primary Contact</td>
</tr>
</tbody>
</table>
Appendix P: Pilot Study Prescreening Survey

https://uttyler.az1.qualtrics.com/jfe/form/SV_bPpiRAaX8jKxuXH
THE UNIVERSITY OF TEXAS AT TYLER

Informed Consent (Online, Anonymous) to Participate in Research

IRB Review Board: Spring 2020
Approval Date: February 5, 2020

You have been asked to take part in this study to learn how Human Resource Development experts can improve career skills training. Taking this survey is your choice, and if you begin the survey and do not want to finish it, you can quit.

If you agree to be in this study, we will ask you to do two things:
1. Answer 12 yes/no and multiple-choice questions about yourself.
2. Answer the questions at one time.

There are not any known risks to this study, other than becoming a little tired of reviewing the info. You are able to quit the survey at any time without harm. The results of this study could
• Improve career skills training.
• Make access to career skills training easier.

All of your answers to the questions are private. If you need to ask questions about this study, you can contact Dr. David Pearson, Chair of the UT Tyler Institutional Review Board at dpearson@uttyler.edu, or 903-565-5858.

I have read and understood what has been explained to me. If I choose to take part in this study, I will click “Yes” in the box below and carry on with the survey. If I choose not to take part, I will click “No” in the box.

☐ yes
☐ no
This is a pre-screening survey. Qualified respondents will be invited to participate in a follow-up survey. Please answer the following 7 yes/no questions about yourself. Remember, there are no right or wrong answers and your responses are anonymous.

Are you employed?
- Yes
- No

Are you currently working from home (your job is remote or you are working remote due to the COVID-19 pandemic)?
- Yes
- No

Do you now, or have you ever, use the computer program Microsoft Teams?
- Yes
- No

Have you experienced a traumatic brain injury that resulted in permanent memory impairment?
- Yes
- No

Do you suffer from Alzheimer’s, Dementia, Korsakoff syndrome, or Parkinson’s disease?
- Yes
- No

Do you self-identify with Attention Deficit Disorder (ADD) or Attention Deficit Hyperactivity Disorder (ADHD)?
- Yes
- No

Do you struggle with reading due to Dyslexia, Dysgraphia, or a reading disorder?
- Yes
- No
Please answer the following 5 demographic questions about yourself. Your answers are confidential.

Please select the option that you best identify with

- Male
- Female

Please select the option that represents your age.

- 18-34
- 35-54
- 55+

Please select the option that most closely resembles your race/ethnicity.

- Asian
- Black
- Hispanic
- White
- Other

Please select the option that most closely represents your educational attainment.

- Did not graduate high school
- High school or equivalent
- Some college, but no degree
- Associate’s degree
- Bachelor’s degree
- Graduate degree
Appendix P (Continued)

Which of the following best describes your occupation?

- Management, professional, and related occupations (management; business and financial operations; computer and mathematical; architecture; engineering; life, physical, and social science; community and social service; legal education, training, and library; arts, design, entertainment, sports, and media; healthcare practitioners and technical).
- Service occupations (healthcare support; protective service; food preparation and serving related; building maintenance and grounds cleaning; personal care and service)
- Sales and office occupations (sales and related, office and administrative support)
- Natural resources, construction, and maintenance (farming, fishing, and forestry; construction and extraction; installation, maintenance, and repair)
- Production, transportation, and material moving occupations
- Other

Your response has been recorded. Thank you for your time and participation. Please copy and paste the following code into the MTurk HIT to receive payment R_1cSxnnHDb6K9ODv
Appendix Q: Pilot Study Treatment Group T1 Survey

https://uttyler.az1.qualtrics.com/jfe/form/SV_dp640AMjPIzqTsx
Appendix Q (Continued)

THE UNIVERSITY OF TEXAS AT TYLER
Informed Consent (Online, Anonymous) to Participate in Research
IRB Review Board: Spring 2020
Approval Date: February 5, 2020

You have been asked to take part in this study to learn how Human Resource Development experts can improve career skills training. Taking this survey is your choice, and if you begin the survey and do not want to finish it, you can quit.

If you agree to be in this study, we will ask you to do two things:
1. Take two and a half minutes to watch a video, then answer 30 multiple-choice questions.
2. Answer the 30 questions at one time.

There are not any known risks to this study, other than becoming a little tired of reviewing the info. You are able to quit the survey at any time without harm. The results of this study could
- Improve career skills training.
- Make access to career skills training easier.
All of your answers to the questions are private. If you need to ask questions about this study, you can contact Dr. David Pearson, Chair of the UT Tyler Institutional Review Board at dpearson@uttyler.edu, or 903-565-5858.
I have read and understood what has been explained to me. If I choose to take part in this study, I will click “Yes” in the box below and carry on with the survey. If I choose not to take part, I will click “No” in the box.

☐ Yes
☐ No
Appendix Q (Continued)

Video Link: https://youtu.be/jugBqE_2sM

Please watch the short video below. Afterwards, you will be asked to answer 30 multiple-choice questions regarding the information presented in the film.
Your responses are very important to this research. Please, read every question and answer to the best of your ability from memory, without looking-up the answers. You will not be penalized for wrong answers and your survey is anonymous.

Answer the following 30 multiple-choice questions regarding your understanding of Microsoft Teams.

1. For a view that lets you catch up on all your unread messages, @mentions, replies, and more, choose ___.
   - tabs
   - activity
   - teams
   - calendar

2. To stay in sync with your team, ___.
   - sync calendar with outlook
   - allow text notifications
   - set-up email notifications
   - download the mobile app

3. To talk privately with a person or a group, click ___.
   - chat icon
   - someone’s profile picture
   - @ mention someone
   - envelope icon

4. To see all team conversations and every file, select the team ___.
   - channel
   - name
   - files
   - activity
Appendix Q (Continued)

5. To see everything you have lined-up for the day or week, go to ____.
   - activity
   - tabs
   - side menu
   - meetings

6. Use ____ to search for specific items or people, take quick actions, and launch apps.
   - tabs
   - files
   - command box
   - channels

7. Teams are made-up of ____.
   - files
   - conversations
   - channels
   - users

8. At the top of each channel, you'll find ____ they are like links to your favorite files, apps, and services.
   - tabs
   - channels
   - activity
   - favorites

9. ____ is where to hold meetings, have team conversations, and share files.
   - tabs
   - files
   - channels
   - dashboard

10. Where can you see a list of all of the teams you are a part of?
    - on the top menu
    - on the left side menu
    - channels
    - tabs
Appendix Q (Continued)

11. You and your team can edit a document at the same time when the file is ___.
   - in files
   - in OneDrive
   - in SharePoint
   - in the channel conversation

12. ___ is where the real work gets done.
   - meetings
   - files
   - channels
   - tabs

13. To make a chat easy to find later, ___.
   - Save it to files
   - tag it
   - move it to favorites
   - give it a name

14. In chat, click on the video button to ___.
   - make a video call
   - record a message
   - send an emoji
   - save a screen shot

15. You can schedule a meeting in calendar or in ___.
   - activity
   - meetings
   - tabs
   - chat

16. To find a list of all the teams you are a part of, select ___.
   - channels
   - files
   - activity
   - teams
Appendix Q (Continued)

17. When you share a file in a channel conversation, you and your team can ___.
   - edit it one at a time
   - share thoughts alongside it
   - read-only
   - make anonymous suggestions

18. To quickly search for people, use the ___.
   - Address book
   - calls icon
   - command box
   - chat icon

19. To make an audio call from a chat, select ___.
   - telephone icon
   - person’s profile picture
   - calls on the left menu
   - meet now

20. To help your team stay organized and have conversations, all in one place, download ___.
   - Channels
   - Microsoft mobile app
   - Teams
   - OneDrive

21. To search for stuff in Microsoft Teams, use the ___.
   - search field
   - command box
   - activity feed
   - search tab

22. To see a feed of everything that has happened lately, select ___.
   - activity
   - calendar
   - teams
   - tabs
Appendix Q (Continued)

23. The mobile app can be downloaded from ____.
   - tabs
   - profile
   - apps
   - menu

24. Teams are made-up of ____.
   - tabs
   - files
   - channels
   - apps

25. To see all the files shared across a channel, in the files menu, select ____.
   - SharePoint
   - OneDrive
   - documents
   - files

26. To see all team conversations and every file, select the team ____.
   - activity
   - channel
   - tab
   - app

27. To start a one-on-one conversation select ____.
   - start a new chat
   - @ mention someone
   - person’s profile picture
   - envelope icon

28. Tabs are used to ____.
   - manage your teams
   - highlight files
   - move between teams
   - organize files
Appendix Q (Continued)

29. To start a meeting select ___.
   ○ video call
   ○ join meeting
   ○ start a new meeting
   ○ meet now

30. To make an audio call from a chat, select ___.
   ○ audio call
   ○ telephone icon
   ○ call contact
   ○ person’s profile picture

---

**Bonus opportunity!** We will be sending you a personal invitation to participate in our follow-up survey. Expect an email from Gaby Lambert in one week. Thank you for your time. Please copy and paste the following code into the MTurk® HIT to receive payment R_SuTst4uQ9eFpYd.
Appendix R: Pilot Study Control Group T1 Survey

https://uttyler.az1.qualtrics.com/jfe/form/SV_7OGhQKwoAOuM233
Informed Consent (Online, Anonymous) to Participate in Research

IRB Review Board: Spring 2020
Approval Date: February 5, 2020

You have been asked to take part in this study to learn how Human Resource Development experts can improve career skills training. Taking this survey is your choice, and if you begin the survey and do not want to finish it, you can quit.

If you agree to be in this study, we will ask you to do three things:

1. Take two and a half minutes to review the document below.
2. Answer 30 multiple-choice questions.
3. Answer the questions at one time.

There are not any known risks to this study, other than becoming a little tired of reviewing the info. You are able to quit the survey at any time without harm. The results of this study could

- Improve career skills training.
- Make access to career skills training easier.

All of your answers to the questions are private. If you need to ask questions about this study, you can contact Dr. David Pearson, Chair of the UT Tyler Institutional Review Board at dpearson@uttyler.edu, or 903-565-5858.

I have read and understood what has been explained to me. If I choose to take part in this study, I will click “Yes” in the box below and carry on with the survey. If I choose not to take part, I will click “No” in the box.

☐ Yes
☐ No
Please take two and a half minutes to review the Microsoft Teams document below. You will be asked to answer 30 multiple-choice questions regarding the material.
Microsoft Teams

Make video and audio calls
Click Video call or Audio call, to call someone from a chat. To dial a number, click Call, or, on the left, and enter a phone number. When you call history and answered in the same area.

@mention someone
To get someone’s attention, type @, then their name or pick from the list that appears. Type e-mail to message everyone in a team or Office 365 to notify everyone who visited this channel.

Reply to a post
Channel posts are sorted by date and then threaded. Find the thread you want to reply to, then click Reply. Add your thoughts and click Send.

Add an emoji, meme, or GIF
Click Send to under the box where you type your message, then pick a meme or sticker from one of the categories. There are also buttons for adding an emoji or GIF.

Click to write the question text
Microsoft Teams

Stay on top of things
Click Activity on the left. The Feed shows you all your notifications and everything that happened lately in the channels you follow. To set up notifications for a channel, choose ... next to the channel name, then Channel notifications.

Share a file
Click Attach under the box where you type messages, select the file location, and then the file you want. Depending on the context of the file, you’ll get options for uploading a copy, sharing a link, or other ways to share.

Add a tab in a channel
Click + by the tabs at the top of the channel, click the app you want, and then follow the prompts. Use Search if you can’t see the app you want.

Work with files
Click Files on the left to see all files shared across all of your Teams. Click Files at the top of a channel to see all files shared in that channel. Click More options... next to a file to see what you can do with it in the channel; you can instantly turn a file into a tab at the top!
Microsoft Teams

Search for stuff

Type a phrase in the command box at the top of the app and press Enter. Then select the Messages, People, or Files tab. Select an item or use the filters to refine your results.

Microsoft Teams

Quick Start Guide

New to Microsoft Teams? Use this guide to learn the basics.

You will not be able to move to the next page until two and a half minutes have passed. When you are ready, please go to the next page to answer 10 multiple-choice questions about Microsoft Teams.
Appendix R (Continued)

Your responses are very important to this research. Please, read every question and answer to the best of your ability from memory, without looking-up the answers. You will not be penalized for wrong answers and your survey is anonymous.

Answer the following 30 multiple-choice questions regarding your understanding of Microsoft Teams.

1. For a view that lets you catch up on all your unread messages, @mentions, replies, and more, choose ___.
   - tabs
   - activity
   - teams
   - calendar

2. To stay in sync with your team, ___.
   - sync calendar with outlook
   - allow text notifications
   - set-up email notifications
   - download the mobile app

3. To talk privately with a person or a group, click ___.
   - chat icon
   - someone’s profile picture
   - @ mention someone
   - envelope icon

4. To see all team conversations and every file, select the team ___.
   - channel
   - name
   - files
   - activity
Appendix R (Continued)

5. To see everything you have lined-up for the day or week, go to ____.
   - activity
   - tabs
   - side menu
   - meetings

6. Use ____ to search for specific items or people, take quick actions, and launch apps.
   - tabs
   - files
   - command box
   - channels

7. Teams are made-up of ____.
   - files
   - conversations
   - channels
   - users

8. At the top of each channel, you'll find ____ they are like links to your favorite files, apps, and services.
   - tabs
   - channels
   - activity
   - favorites

9. ____ is where to hold meetings, have team conversations, and share files.
   - tabs
   - files
   - channels
   - dashboard

10. Where can you see a list of all of the teams you are a part of?
    - on the top menu
    - on the left side menu
    - channels
    - tabs
Appendix R (Continued)

11. You and your team can edit a document at the same time when the file is ___.
   - in files
   - in OneDrive
   - in SharePoint
   - in the channel conversation

12. ___ is where the real work gets done.
   - meetings
   - files
   - channels
   - tabs

13. To make a chat easy to find later, ___.
   - Save it to files
   - tag it
   - move it to favorites
   - give it a name

14. In chat, click on the video button to ___.
   - make a video call
   - record a message
   - send an emoji
   - save a screen shot

15. You can schedule a meeting in calendar or in ___.
   - activity
   - meetings
   - tabs
   - chat

16. To find a list of all the teams you are a part of, select ___.
   - channels
   - files
   - activity
   - teams
Appendix R (Continued)

17. When you share a file in a channel conversation, you and your team can ___.
   - edit it one at a time
   - share thoughts alongside it
   - read-only
   - make anonymous suggestions

18. To quickly search for people, use the ___.
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   - command box
   - chat icon

19. To make an audio call from a chat, select ___.
   - telephone icon
   - person’s profile picture
   - calls on the left menu
   - meet now

20. To help your team stay organized and have conversations, all in one place, download ___.
   - Channels
   - Microsoft mobile app
   - Teams
   - OneDrive

21. To search for stuff in Microsoft Teams, use the ___.
   - search field
   - command box
   - activity feed
   - search tab

22. To see a feed of everything that has happened lately, select ___.
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   - calendar
   - teams
   - tabs
23. The mobile app can be downloaded from ___.
   - tabs
   - profile
   - apps
   - menu

24. Teams are made-up of ___.
   - tabs
   - files
   - channels
   - apps

25. To see all the files shared across a channel, in the files menu, select ___.
   - SharePoint
   - OneDrive
   - documents
   - files

26. To see all team conversations and every file, select the team ___.
   - activity
   - channel
   - tab
   - app

27. To start a one-on-one conversation select ___.
   - start a new chat
   - @ mention someone
   - person's profile picture
   - envelope icon

28. Tabs are used to ___.
   - manage your teams
   - highlight files
   - move between teams
   - organize files
Appendix R (Continued)

29. To start a meeting select ____.
   - video call
   - join meeting
   - start a new meeting
   - meet now

30. To make an audio call from a chat, select ____.
   - audio call
   - telephone icon
   - call contact
   - person’s profile picture

Bonus opportunity! We will be sending you a personal invitation to participate in our follow-up survey. Expect an email from Gaby Lambert in one week. Thank you for your time. Please copy and paste the following code into the MTurk® HIT to receive payment R_5uTs4kuQ9eFpYd.
Appendix S: Pilot Study Treatment and Control Groups T2 Survey

Treatment Group:  https://uttyler.az1.qualtrics.com/jfe/form/SV_3KTLTZrUYJTIQ7X
Control Group:  https://uttyler.az1.qualtrics.com/jfe/form/SV_a4rCWPIVAfQqYN7
Appendix S (Continued)

THE UNIVERSITY OF TEXAS AT TYLER

Informed Consent (Online, Anonymous) to Participate in Research

IRB Review Board: Spring 2020

Approval Date: February 5, 2020

You have been asked to take part in this study to learn how Human Resource Development experts can improve career skills training. Taking this survey is your choice, and if you begin the survey and do not want to finish it, you can quit.

If you agree to be in this study, we will ask you to do two things:
1. Complete 10 multiple-choice questions about the material you reviewed last week.
2. Answer the 10 questions at one time.

There are no known risks to this study, other than becoming a little tired of reviewing the info. You are able to quit the survey at any time without harm. The results of this study could

* Improve career skills training.
* Make access to career skills training easier.

All of your answers to the questions are private. If you need to ask questions about this study, you can contact Dr. David Pearson, Chair of the UT Tyler Institutional Review Board at dpearson@uttyler.edu, or 903-565-5851.

I have read and understood what has been explained to me. If I choose to take part in this study, I will click “Yes” in the box below and carry on with the survey. If I choose not to take part, I will click “No” in the box.

☐ Yes
☐ No
Appendix S (Continued)

You recently reviewed some information regarding Microsoft Teams. Your responses are very important to this research. Please, read every question and answer to the best of your ability from memory, without looking-up the answers. You will not be penalized for wrong answers and your survey is anonymous.

1. To stay in sync with your team, ___.
   - sync calendar with outlook
   - allow text notifications
   - set-up email notifications
   - download the mobile app

2. At the top of each channel, you’ll find _____ they are like links to your favorite files, apps, and services.
   - tabs
   - channels
   - activity
   - favorites

3. You and your team can edit a document at the same time when the file is ____.
   - in files
   - in OneDrive
   - in SharePoint
   - in the channel conversation

4. ____ is where the real work gets done.
   - meetings
   - files
   - channels
   - tabs
Appendix S (Continued)

5. To make a chat easy to find later, ___.
   - Save it to files
   - tag it
   - move it to favorites
   - give it a name

6. When you share a file in a channel conversation, you and your team can ___.
   - edit it one at a time
   - share thoughts alongside it
   - read-only
   - make anonymous suggestions

7. To help your team stay organized and have conversations, all in one place, download ___.
   - Channels
   - Microsoft mobile app
   - Teams
   - OneDrive

8. To see all the files shared across a channel, in the files menu, select ___.
   - SharePoint
   - OneDrive
   - documents
   - files

9. To start a meeting click on ___.
   - video call
   - join meeting
   - start a new meeting
   - meet now

10. Teams are made-up of ___.
    - tabs
    - files
    - channels
    - apps
Thank you for your time. Please copy and paste the following code into the MTurk® HIT to receive payment and bonus R_1nVh3csBgl5SaPl.
Appendix T: Pilot Study MTurk® HITS

Prescreening Survey

Project Name: Screening
This name is not displayed to Workers.

Describe your survey to Workers

Title: Two Minute Survey About You
Describe the survey to Workers. Be as specific as possible, e.g., "answer a survey about movies," instead of "short survey," so Workers know what to expect.

Description: Answer 12 short questions about yourself
Give more detail about this survey. This gives Workers a bit more information before they decide to view your survey.

Keywords: survey, demographics
Provide keywords that will help Workers search for your tasks.

Setting up your survey

Reward per response: 0.25
This is how much a Worker will be paid for completing your survey. Consider how long it will take a Worker to complete your survey.

Number of respondents: 766
How many unique Workers do you want to complete your survey?

Time allotted per Worker: 1
Maximum time a Worker has to complete the survey. Be generous so that Workers are not rushed.

Survey expires in: 7
Maximum time your survey will be available to Workers on Mechanical Turk.

Auto-approve and pay Workers in: 1
This is the amount of time you have to reject a Worker's assignment after they submit the assignment.

Worker requirements

Require that Workers be Masters to do your tasks (Who are Mechanical Turk Masters?):

Yes ☐ No ☐

Specify any additional qualifications Workers must meet to work on your tasks:

- first wave: has not been granted
- pilot: has not been granted
- Location: is United States (US)

[Add another criterion (up to 2 more)]
(Premium Qualifications incur additional fees, see Pricing Details to learn more)

Project contains adult content: [See details]
This project may contain potentially explicit or offensive content, for example, nudity.

Task Visibility: [What is task visibility?]
☐ Public - All Workers can see and preview my tasks
☐ Private - All Workers can see my tasks, but only Workers that meet all Qualification requirements can preview my tasks
☐ Hidden - Only Workers that meet my Qualification requirements can see and preview my tasks
Appendix T (Continued)

**T1 Treatment Group**

<table>
<thead>
<tr>
<th>Project Name:</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Describe your survey to Workers</strong></td>
<td></td>
</tr>
<tr>
<td>Title</td>
<td>Follow-Up Survey</td>
</tr>
<tr>
<td>Description</td>
<td>Watch a 2 1/2 minute video and answer 30 multiple-choice questions</td>
</tr>
<tr>
<td>Keywords</td>
<td>survey; demographics</td>
</tr>
<tr>
<td><strong>Setting up your survey</strong></td>
<td></td>
</tr>
<tr>
<td>Reward per response</td>
<td>$1.00</td>
</tr>
<tr>
<td>Number of respondents</td>
<td>1</td>
</tr>
<tr>
<td>Time allotted per Worker</td>
<td>1 Hours</td>
</tr>
<tr>
<td>Survey expires in</td>
<td>6 Days</td>
</tr>
<tr>
<td>Auto-approve and pay Workers In</td>
<td>1 Days</td>
</tr>
<tr>
<td><strong>Worker requirements</strong></td>
<td></td>
</tr>
<tr>
<td>Require that Workers be Masters to do your tasks (Who are Mechanical Turk Masters?)</td>
<td>Yes</td>
</tr>
<tr>
<td>Specify any additional qualifications Workers must meet to work on your tasks:</td>
<td>treatment 1 equal to 1</td>
</tr>
<tr>
<td>Project contains adult content (See details)</td>
<td></td>
</tr>
<tr>
<td>This project may contain potentially explicit or offensive content, for example, nudity.</td>
<td></td>
</tr>
<tr>
<td>Task Visibility (What is task visibility?)</td>
<td>Public: All Workers can see and preview my tasks</td>
</tr>
</tbody>
</table>
Appendix T (Continued)

**T1 Control Group**

<table>
<thead>
<tr>
<th>Project Name:</th>
<th>Control</th>
</tr>
</thead>
</table>

**Describe your survey to Workers**

- **Title:** Follow-up Survey
- **Description:** Review lesson material for two and a half minutes, then answer 30 multiple-choice questions
- **Keywords:** survey, demographics

**Setting up your survey**

- **Reward per response:** $1.00
  - This is how much a Worker will be paid for completing your survey. Consider how long it will take a Worker to complete your survey.
- **Number of respondents:** 12
  - How many unique Workers do you want to complete your survey?
- **Time allotted per Worker:** 1 Hours
  - Maximum time a Worker has to complete the survey. Be generous so that Workers are not rushed.
- **Survey expires in:** 6 Days
  - Maximum time your survey will be available to Workers on Mechanical Turk.
- **Auto-approve and pay Workers in:** 1 Days
  - This is the amount of time you have to reject a Worker's assignment after they submit the assignment.

**Worker requirements**

- **Require that Workers be Masters to do your tasks (who are Mechanical Turk Masters?)**
  - Yes ☐ No ☐
- **Specify any additional qualifications Workers must meet to work on your tasks:**
  - controlT1 = 2

**Premium Qualifications (up to 4 more, see Pricing Details to learn more)**

**Project contains adult content (see terms)**

- Yes ☐ No ☐
  - This project may contain potentially explicit or offensive content, for example, nudity.

**Task Visibility (what is task visibility?)**

- Public - All Workers can see and preview my tasks.
- Private - All Workers can see my tasks, but only Workers that meet all Qualification requirements can preview my tasks.
- H100Hit - Only Workers that meet my Qualification requirements can see and preview my tasks.
Appendix T (Continued)

T2 Treatment Group

<table>
<thead>
<tr>
<th>Project Name</th>
<th>T2 Treatment</th>
</tr>
</thead>
</table>

**Describe your survey to Workers**

- **Title**: Follow-Up Survey – 2 Minutes
- **Description**: Answer 10 multiple-choice questions about Microsoft Teams
- **Keywords**: survey, demographics

**Setting up your survey**

- **Reward per response**: $0.5
- **Number of respondents**: 1
- **Time allotted per Worker**: 1 Hours
- **Survey expires in**: 7 Days
- **Auto approve and pay Workers in**: 3 Days

**Worker requirements**

- **Requires that Workers be Masters to do your tasks**: [ ] Yes [ ] No
- **Specify any additional qualifications Workers must meet to work on your tasks**: [ ] treatment questions [ ] equal to [ ] 6
- **Project contains adult content**: [ ] Check

**Task Visibility**

- **Public**: All Workers can see and preview my tasks
- **Private**: Only Workers that meet all Qualification requirements can preview my tasks
- **Hidden**: Only Workers that meet my Qualification requirements can see and preview my tasks
### T2 Control Group

<table>
<thead>
<tr>
<th>Project Name:</th>
<th>T2 Control</th>
<th>This name is not displayed to Workers.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Describe your survey to Workers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Title</strong></td>
<td>Follow-Up Survey - 2 MindRQ</td>
<td></td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Answer 10 multiple-choice questions about Microsoft Teams</td>
<td>(Give more detail about this survey. This gives Workers a lot more information before they decide to view your survey.)</td>
</tr>
<tr>
<td><strong>Keywords</strong></td>
<td>Surveys, demographic</td>
<td>Provide keywords that will help Workers search for your tasks.</td>
</tr>
<tr>
<td><strong>Setting up your survey</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reward per response</strong></td>
<td>0.5</td>
<td>This is how much a Worker will be paid for completing your survey. Consider how long it will take a Worker to complete your survey.</td>
</tr>
<tr>
<td><strong>Number of respondents</strong></td>
<td>12</td>
<td>How many unique Workers do you want to complete your survey?</td>
</tr>
<tr>
<td><strong>Time allotted per Worker</strong></td>
<td>1 Hours</td>
<td>Maximum time a Worker has to complete the survey. Be generous so that Workers are not rushed.</td>
</tr>
<tr>
<td><strong>Survey expires in</strong></td>
<td>7 Days</td>
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</tr>
<tr>
<td><strong>Auto-approve and pay Workers in</strong></td>
<td>3 Days</td>
<td>This is the amount of time you have to reject a Worker’s assignment after they submit the assignment.</td>
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<tr>
<td><strong>Worker requirements</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Require that Workers be Masters to do your tasks (Who are Mechanical Turk Workers?)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Specify any additional qualifications Workers must meet to work on your tasks:</strong></td>
<td>control questions</td>
<td>equal to</td>
</tr>
<tr>
<td><strong>(Optional qualifications (up to 4 rows))</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Project contains adult content?</strong></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Task Visibility (make task visible to all Workers)</strong></td>
<td>Public: All Workers can see and preview my tasks.</td>
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</tbody>
</table>