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Physical Preservation of 35 mm Slides: Methods and Standards
By Julia Meier

Readers: Dr. Stacy Creel, Dr. Jeffery Hirschy

INTRODUCTION
A color transparent image surrounded by a frame made of plastic or cardboard, which fits in the palm of most hands, is a unique form of photography from the 20th century. This tiny transparency, which comes both in greyscale and color, was a popular form of photography in the middle of the 20th century. 35 mm film, named for its 35 mm width, was first created in the 1930s and started to gain popularity in the 1940s (Ang, 2014; Rosenblum, 1997). This was due to the fact that slide transparencies, which are positive transparencies, had a higher quality and finer grain than other color negatives and created a sharper image (Rosenblum, 1997). By the time, the 1950s and 1960s hit, 35 mm slides had become very common in both commercial and domestic photography. By the late 20th century with the development of other types of photography, including digital, as well as the rise of television, 35 mm film fell out of popularity (Ang, 2014).

With 35 mm slides being such a widely popular format throughout the 20th century, it is no wonder why they hold a great deal of history from that era within their tiny frames. As pieces of history, 35 mm slides are valuable documentary materials, and to keep the history they contain alive, they must be physically preserved.

Purpose Statement
The purpose of this content analysis study was to gather and determine physical preservation methods and standards for the preservation of 35 mm slides from peer-reviewed journals and other published sources from 1980-2021.

Research Questions
R1. What peer-reviewed articles are there on physical preservation methods of 35 mm slides from 1980-2021?

R2. What non-peer-reviewed sources are there on physical preservation methods of 35 mm slides from 1980-2021?

R3. What sources from 1980-2021 on physical preservation methods for photography can be applied to the physical preservation of 35 mm slides?

R4. What standards or methods of physical preservation are there for 35 mm slide photographs?

Definitions
35 mm film: A type of film that is 35 mm wide from edge to edge (Kroon, 2014).

Air Bulbs: A tool used in archival preservation that creates a puff of air. It is usually used to remove dust and dirt from an object without touching it (Ritzenthaler & Vogt-O’Connor, 2006).

Buffered: In reference to archival storage materials, this means that the material in question has added an agent to make it alkaline (National Park Service, 1995).

Cellulose acetate: A type of safety film, made of plastic, that has hydrolyzed cellulose in its composition (Society of American Archivists, 2020).

Cellulose nitrate: A type of plastic that at one point was commonly used for film. Due to its composition being mostly made up of a celluloid known as nitrocellulose, it was highly flammable and unstable. It was discontinued in the 1950s (Health and Safety Executive, 2013).

Color shift/ color shifting/ color balance shift: When the colors of a photograph or image change due to one or more types of dye fading faster than the others (Kroon, 2014).

Color transparency: A color image manufactured on a transparent medium, like film or glass, that is viewed by projecting light through the image (Ang, 2014).

Content Analysis: A type of research that focuses on particular terms, topics, and themes within qualitative data (Columbia University Irving Medical Center, 2022).
Digitization: In the context of preservation of 35 mm slides, it is “the conversion of analogue data,” the physical slides, “into digital forms” (Oxford University Press, 2022, para. 1).

Dots per inch (dpi): A measurement of print resolution. The higher the number, the more dots of ink per inch there are and the higher the resolution of the image is (Ang, 2014).

DSLR: A single-lens reflex digital camera (Chen et al., 2022).

Dye Coupler: Used in chromogenic photographic processes, this “colorless chemical compound reacts with [a] oxidized developer to” create dye or color in a photo (Pénichon, 2013, p.313).

Emulsion: A coating that is light-sensitive, which is used to create an image in photographic films and prints (Pénichon, 2013).

Fade: The slow deterioration of an image or photograph over time due to the dyes that make up the picture (Koon, 2014).

Fungicide: A compound used to destroy or put mold and its spores in a dormant state (Lavédrine, 2009, p. 325).

Lignin: A part of woody fibers that makes them rigid as well as the main cause of acidity within paper (Ritzenthaler & Vogt-O’Connor, 2006).

Monochrome: In reference to a photograph or slide, it is an image that is made up of only black, white, and gray tones that can be tinted (Ang, 2014, p. 466).

Negative: A type of image where the “colors and areas of light and dark are reversed” (Ang, 2014, p. 466).

Photographic Activity Test (PAT): A test from the International Standard Organization (ISO) that “explores the possibility of chemical interactions between photographs and a given material after prolonged contact” to determine if the material is safe for use with photographs and their storage (Image Permanence Institute, n.d., para. 1).

Polyester: A plastic material used as bases for film (Lavédrine, 2009).

Positive: The opposite of a negative image. It is a type of image where the “colors in areas of light and dark match the scene, object, or figure they represent” (Ang, 2014, p. 467).

Relative Humidity (RH): The percent of humidity in relation to the temperature of the air at the time the measurement was taken (NOAA’s National Weather Service, 2015).

Safety Film: A type of film made from cellulose triacetate and polyester film base which replaced the highly flammable and unstable nitrate base film (Lavédrine, 2009).

Slide: In terms of photography, it is a positive transparency that has been mounted to assist in viewing through projection (Society of American Archivists, 2022).

Transparency: A type of positive image photograph that is viewed by transmitting light through the image (Lavédrine, 2009).

Unbuffered: In reference to archival storage materials, it is a material that is pH neutral and acid-free (National Park Service, 1995).

Ultraviolet Radiation (UV): A form of radiation produced from light sources (Centers for Disease Control and Prevention (CDC), 2022).

Delimitations
This study focused on physical preservation methods of 35 mm slides mentioned in published sources and peer-reviewed articles from 1980-2021. It also included sources that had related information which can be applied to the physical preservation of 35 mm slides. The sources came from the University of Southern Mississippi library’s digital resources, the Somerset County Library System of New Jersey’s resources, as well as sources that could be interlibrary loaned through these institutions. This study included both print and e-resources. E-resources outside these institutions were limited to those from museum, archive, library, and government websites. This study did not focus on digital preservation as a physical preservation method because in digital preservation a new digital entity is created, one that is a copy of the original, not the physical preservation of the original item. This study focused on the preservation of the
original item only, not the creation of a facsimile of the original.

Assumptions
It was assumed that the sources from the University of Southern Mississippi’s and Somerset County Library System of New Jersey’s collections on the topics of physical preservation of 35 mm slides and related information were accurate and correct. Additionally, it was assumed that both the print and e-resources available through these institutions were created by reliable and reputable sources. The additional e-resources found outside these institutions on museum, archive, library, and government websites were assumed to be reputable, accurate, correct, and dependable as well.

Importance of Study
This study provides information on the methods that are used and can be used for the physical preservation of 35 mm slides. This is important to not only the archival and museum fields, but to the library and information science fields as well. Since 35 mm slides have been used both commercially and domestically in so many different ways, they have documented much of the history of the mid-20th century. Now 35 mm slides are showing up as historical documentary materials in archives, museums, and libraries creating a need for these institutions to properly preserve and conserve them for future use. 35 mm slides and film are aging as all things do and need proper preservation to ensure they will last for future generations. It is hoped that this study can be valuable to researchers, people who work with 35 mm slides and preservation, and those who would like to learn more about physical preservation methods for 35 mm slides.

LITERATURE REVIEW
Popularity of Digitization as Preservation for 35 mm Slides
35 mm slides comprised of 35 mm wide film, processed as a positive transparency, and usually framed in cardboard, metal, or plastic, are small photographs that can easily be projected to produce a larger form of the image it contains (Pénichon, 2013). These small pieces of photography were popular in the 20th century. Due to their popularity within the public, commercial, and academic fields, these little slides contain a great deal of historic value and information from the last century, causing those who preserve history to have to deal with preserving what they contain (Wilhelm & Brower, 1993). Looking at sources which talk about the preservation of 35 mm slides, the preferred method seems to be digitization, which is chosen over physical preservation or conservation of the slides themselves (Lavédrine, 2009).

The preference for digitization as a method of preservation is expected due to the prevalence of modern digital technology. Lavédrine (2009) mentioned that digitization, which is the creation of a copy or counterpart within a digital format of the original, is a preferred method of preservation in a wide range of fields. Oleen and Olsen’s article from 2011 supported this. Their article about the digitization of agricultural slides for academic use focused solely on making digital copies of the collection of slides without mentioning what will become of the originals. Regennitter’s (2000) article from 9 years prior did the same. His article on how to plan for a digitization project of 35 mm slides was based in the dental and orthodontic fields. The thought process behind the suggested digitization was not for preservation needs but for updating to current technology. At the time of the article, medical fields were in the process of transferring physical copies of patient records to computer-based records, giving another reason to make digitization a preferred method when dealing with 35 mm slides (Regennitter, 2000). A 2020 article by Fernández discussed methods of digitizing archaeology slides with a DLSR camera. Fernández’s (2020) preference for digitization over physical preservation was based on cost efficiency.

Besides promoting the digitization of 35 mm slides, these pieces also shared the goal of providing easier and wider access to the information that the slides hold. Bellacosa’s article discussed access as a major factor that institutions must consider when dealing with collections. In Jerrido, Cotilla, and Whitehead’s 2001 study, they also mentioned that the reasoning for digitization was for access. In that case, the collection of slides mentioned were used by a horticulture class. This required the students to use the collection in person, which was limited by the library’s hours. By digitizing the slides, the students no longer had to work around the library’s opening hours and could now access them at any time and place they would like (Jerrido et al., 2001).
Providing access through digitization was not a new idea for 35 mm slides. Looking at Regennitter’s (2000) article and the sources he cited, digitization was happening in the 1990s. He was not so much promoting access and preservation in his article but for its ease of use. Within the first page, he mentioned that the reasoning behind the digitization push was to adapt to the recent technology within the field. As Regennitter (2000) wrote, “digital images are the raw materials for presentations in the Information Age” (p.110). Therefore, the images 35 mm slides contain need to conform to modern standards (Regennitter, 2000).

As technology changes so do the knowledge and skills required to use it. Those who have grown up using computers and digital technology find it easier to work with digital mediums (Oleen & Olsen, 2011). “Digital images are now the norm” (Oleen & Olsen, 2011, p. 375). This is true when it comes to those who fit under the titles of students and researchers, since in today’s digital age it is easier and less time consuming to download or access a piece of information through a digital source than in person. Especially if one can do it from home and without having to travel out of their way to access it. Oleen and Olsen (2011) brought up the points that with digitization, not only is ease of access provided, but it is also “a way to insure that future students and researchers use these unique and important materials” (p. 375).

Besides access and conforming to new digital technology for ease of use, digitization can also be seen as a way to prevent further damage to the original slides. The goal of VanSnick and Ntanos’ (2018) study was to assess the change in demand for access to the physical collections after the digital copy was made available. Their results showed that by making the digital copy available, it improved the usage of that collection. Additionally, the handling of the original collection was reduced by 99 percent (VanSnick & Ntanos, 2018). Digitization is a way to promote and provide wider access as well as prevent further damage to the materials done by handling them.

**Digitization is Not Preservation**

Even though digitization greatly improves access and sometimes ease of use for 35 mm slide collections, digitization is not a true form of preservation. It can be a tool to assist in preventing further damage due to handling. VanSnick and Ntanos’ (2018) article pointed out that this can be a form of preventative care. However, when digitizing a 35 mm slide or any other photograph or object, the result is a digital copy or surrogate. The digital version is not a replacement for the original. Instead, it is a creation of a new entity (Fernández, 2017). Burns (2017) and Conway’s (2014) articles drove home this point of the creation of digital copies and surrogates, and their need to be treated as separate entities. They will need to be preserved in addition to the originals. Looking at how fast digital technology changes, evolves, and improves, preservation of these digital surrogates can be just as tricky as preserving the original.

When creating a copy, the quality of the copy will not be the same as the original, nor will it hold exactly the same information. With the improvement of digital technology over the years, the ability to digitize photographs and documents has improved. However, it is still not an ideal way of replacing or preserving the original source. A 1999 article by Rumsey mentioned that digitization is not a true replacement for trying to preserve the original source. Due to rapid advancement of technology a current scan of an object would always be of lower quality than a future scan (Rumsey, 1999). Regennitter’s (2000) article was scanning slides in 300-400 dots per inch (dpi) because of the storage space of the compact discs he was using. Compare that to Matusiak and Johnston’s 2014 article where they were scanning 35 mm slides at 4,000 dpi. The quality is only likely to improve further. Another issue to note with digital copies is how they are stored. Regennitter (2000) noted that he stored his digital copies on rewriteable compact discs, which Note’s (2019) chapter on digital preservation mentioned that compact discs were becoming obsolete. When storing digital copies, the storage place and format must be considered or else the copies could be lost due to lack of ability to access the file.

Another issue about making a digital copy or making any sort of copy of an original, is that it is not exactly the same no matter how similar it looks. Additionally, digitizing some things can be almost virtually impossible. Weidner (2013) brought up this point with the mention of an art installation that used 35 mm slides. Since the piece used 35 mm slides and projectors to create the art, it is virtually impossible to try to convert it into a digital format. The slides themselves could easily be scanned and digital copies could be created, but what about the artist’s concept? When an artist creates an art piece, they have a
specific vision or concept in mind. The artist chose to use 35 mm slides projected with a slide projector to express their vision. By trying to turn all the aspects of the piece digital, it would change the artist’s vision and alter the piece of art (Weidner, 2013).

Studies with Similar Methodologies

While the studies below do not necessarily deal with 35 mm slides, photography, preservation, or archives, their methodologies helped form the methodology for this study. Uzunboylu and Genc (2017) used mixed methods that applied both document and content analysis methods. Their study focused on making an analysis of documents published within a specific database that dealt with learning foreign languages through mobile learning. While this study also used content analysis, their study followed the definition of content analysis where the focus is on compiling and presenting data in a way that readers of the study will understand (Uzunboylu & Genc, 2017).

Faulkner, Klock, and Gale’s (2002) study on qualitative research in family therapy publication trends also assisted in shaping this study’s methodology. Their research questions were looking for the what in dealing with their topic. For example, their first question was, “What are the qualitative research publication trends over the past 20 years?” (Faulkner, et al., 2002, p. 69). These questions are similar to those in this study. Faulkner, Klock, & Gale’s (2002) methodology also included doing further analysis on found articles. This study included a similar method.

Rinto, Bowles-Terry, and Santos’ (2016) study emulated similar methodologies to both previous studies. In their study on first-year students’ research papers, they use content analysis to examine both the topics the papers are on as well as the students’ research skills which went into the papers. Similar to Rinto, Bowles-Terry, and Santos (2016), this study looked at what methods of preservation and conservation are suggested within the sources found.

METHODOLOGY

This collection analysis study aimed to find and identify sources and information on the preservation and conservation of 35 mm slides. The study was conducted by searching a selection of databases and collections with specific search terms. The results from those searches were gathered and documented in two spreadsheets and a Word document. The results from the sources were evaluated on the information they contained. The sources that were selected answered the research questions with that information.

Information Sources

The selection of databases and collections that were used in this study were the University of Southern Mississippi (USM)’s library catalog, Somerset County Library System of New Jersey (SCLSNJ)’s library catalog, EBSCOHost databases which are offered through both USM and SCLSNJ, and two specific websites: the National Parks Service’s Conserve o’ Grams and the National Archives. The EBSCOHost databases chosen for this study included Academic Search Premier, Agricola, America: History & Life, Art & Architecture Complete, Book Collection: Nonfiction, eBook Academic Collection, eBook Collection, eBook Open Access (OA) Collection, Information Science & Technology Abstracts (ISTA), Library & Information Science Source, Library, Information Science & Technology Abstracts, MasterFILE Premier, and TOPICsearch. These databases were chosen based on their relevance to the subject matter of this study. Each one of these databases contained articles and sources related to 35 mm slides and film. If articles or sources were not available in full-text format digitally through any of these databases or catalogs and it had or could potentially have relevant information to this study’s research questions and goals then it was obtained by borrowing a physical or digital copy through USM, SCLSNJ, or via interlibrary loan.

Procedures

Two spreadsheets and a word processing document were created prior to the initial research. The first spreadsheet, called “Initial Source Pull” had a tab for each collection and database. These tabs included: USM’s library catalog, SCLSNJ’s library catalog, EBSCOHost databases, and Websites. Each tab had a table with the columns of title, author(s), publication date, type of source, and link to source/record. The second spreadsheet, titled “Selected Sources,” had a similar setup but with only two tabs: sources picked for further analysis and final sources. The word processing document, titled “Final Sources Review,” was a running list of the final selected titles with summaries and information gleaned from the sources. After the creation of the recording documents, the initial search for sources was conducted. Each database and collection listed in the “Information
Sources’ section of this study was searched with similar search terms.

Databases were searched all at once with no field limiters using these terms: “35mm slide* AND Conserve* OR Preserve*”, “35 mm slide* AND Conserve* OR Preserve*”, “35 mm film AND Conserve* OR Preserve*”, “35mm film AND Conserve* OR Preserve*”, and “photograph* AND Conserve* OR Preserve*”.

The SCLSNJ’s library catalog was searched using the terms: “35 mm slide*”, “35mm slide*”, “35mm film”, “35 mm film”, “Conservation AND photo*”, and “Preservation AND photo*”. USM’s library catalog was searched with the terms “Archival preservation AND Photo*” in the subject field; “Conserve* AND Photo* NOT Digital*” in the title and subject fields; and “Preserve* AND Photo* NOT Digital*” in the title and subject fields.

The two websites were searched differently. The section of the National Archives site on preservation and conservation resources was searched manually by looking at the sources that related to the preservation and conservation of photography and film. For the National Parks Service, only the webpage with the Conserve O’ Grams was searched. Like the National Archives, it was searched manually by looking at the pamphlets that were related to the preservation and conservation of photography and film.

When sources were discovered, they were recorded within the “Initial Source Pull” spreadsheet. Each source that had been found to be possibly relevant with the initial search and indicated to be possibly useful with a quick analysis of its summary, had its title, author(s), publication date, type of source, and the permanent link to the source recorded within the spreadsheet. The “type of source” column was limited to the following types: book, article, peer-reviewed article, and web-based source. Book covered all published bound print materials and those categorized as eBooks. Article covered any source that was categorized as an article but was not from a peer-reviewed source. Peer-reviewed articles were articles from peer-reviewed journals. Web-based sources were used for sources which were available via the internet that did not fall under any of the other categories. During the initial search any of the sources that were available for immediate digital download were downloaded and kept in a folder titled “35_mm_Study_Initial.”

After the initial search and recording of sources, the next step was to sort through the found sources. In the first elimination round, the sources were looked at for content. This was done by skimming the sources to see if they contained possible relevant or related information on the preservation or conservation of 35 mm slides. Any source that was deemed as a possibly relevant source was highlighted green in the spreadsheet “Initial Source Pull” spreadsheet. Any source that did not pass was eliminated and had their row struck through. Once all the sources had gone through this elimination step, those that were highlighted green were copied to the second spreadsheet, “Selected Sources.”

After the sources had been narrowed down, they were checked for obtainability. Those that were obtainable through the internet via the web or digital download were highlighted in light purple. Sources that needed to be obtained physically from SCLSNJ’s collection were highlighted in teal and those from USM were highlighted in yellow. Any source that was interlibrary loaned from SCLSNJ or USM was highlighted in light blue until obtained. Once obtained, the source was highlighted in a darker blue. If for some reason the source could not be obtained it was highlighted in red. Only the sources that were obtained were analyzed during the next step.

Once all the sources that were found in full text were obtained, they were analyzed in greater detail than in the two previous analysis steps. At this point, the results of the further analysis were recorded in the word processing document, “Final Sources Review.” Each source had their title, author, and publication year recorded within the word processing document. In addition, a summary of the information within the source and any valuable information that stood out about or in relation to the preservation and conservation of 35 mm slides was included.

Limitations
This study’s results were limited to the accuracy and content of the selected library collections, databases, and websites.
RESULTS
After the initial searches through the databases, library catalogs, and websites, a total of 58 sources from 1980-2021 were found. Out of those 58 sources, 36 were deemed to contain information relating to the physical preservation of 35 mm slides or of photography. During the further analysis stage of these 36 sources, which included finding ways of obtaining some of these sources which were not readily available, not all were able to be examined further. An Ounce of Preservation by Craig Tuttle was unable to be used due to the book being unable to leave the state. Archives & Manuscripts: Administration of Photographic Collections by Mary Lynn Ritzenhaler and The Life of a Photograph: Archival Processing, Matting, Framing, and Storage by Laurence E. Keefe were not loanable. Twentieth-Century Color Photographs: Identification and Care by Sylvie Pénichon and The Permanence and Care of Color Photographs: Traditional and Digital Color Prints, Color Negatives, Slides, and Motion Pictures by Henry Wilhelm and Carol Brower were both able to be interlibrary loaned. Wilhelm and Brower’s book is also available online via pdf off their website for free.

During the initial search phase, a lot of the sources found that did not apply were advocating digitization as preservation. These sources were not included since this study focuses on the physical preservation of 35 mm slides. This was also the reason sources were eliminated during the content analysis phase. Other sources which did not make the cut did not include information that was relevant to the physical preservation of 35 mm slides after closer inspection. In the end, only 20 sources were found to fit the criteria in the methodology and answer this study's research questions (Figure 1).

Figure 1: Total Number of Sources per Type from 1980-2021, n=20

R1. What peer-reviewed articles are there on physical preservation methods of 35 mm slides from 1980-2021?
Within the limitations and collections searched within this study, there were no peer-reviewed articles on physical preservation methods of 35 mm slides from 1980-2021. The only peer-reviewed articles discovered were deemed not applicable to the study since they focused on the digitization of 35 mm slides not the physical preservation of the original slide.

R2. What non-peer-reviewed sources are there on physical preservation methods of 35 mm slides from 1980-2021?
Out of the final 20 sources found in this study, only one source was solely about the physical preservation of 35 mm slides. This was Caldararo and Grigg’s
article “Preliminary Report on the Conservation of Slides with Special Reference to the Removal of Mold” (2001). Their article focused solely on methods of removal of mold from 35 mm slide photographs and did not include information for other types of preservation of photography. However, within the rest of the 20 sources selected, there were four that have a section about or mentioned 35 mm slides. These sources also contained information on preservation or conservation for other types of photography. From the National Archives website, the article titled “What is the Best Way to Store Negatives and Transparencies?” covered preservation practices of 35 mm slides as well as other types of transparencies and negatives (2017). The three books found in the search had small sections relating to 35 mm slides. Twentieth-Century Color Photographs Identification and Care by Sylvie Pénichon had multiple pages and sections throughout her book on 35 mm slides which included preservation practices for specific types of deterioration, in addition to having a section on the history and photographic processes used to create 35 mm slides (2013). Pénichon’s book (2013), had some of the most information about 35 mm slides out of the four book sources, however, Wilhelm and Brower’s book The Permanence and Care of Color Photographs: Traditional and Digital Color Prints, Color Negatives, Slides, and Motion Pictures (1993) devoted a whole chapter to one type of deterioration of 35 mm slides in addition to including information about 35 mm slides in other chapters. Ritzenthaler and Vogt-O’Connor’s book Photographs Archival Care and Management had a smaller section devoted to 35 mm slides and the information was placed under x-rays and transparencies (2006).

Another book that was found within this study was The Film Photography Handbook by Marquardt and Andrae (2019). There was a section on 35 mm slides, however, it mainly focused on the history and what cameras to use with 35 mm film instead of preservation practices, especially for 35 mm slides (Marquardt & Andrae, 2019). It was not counted for this research question due to having only general information about the preservation of photographs in the back of the book and nothing on transparencies that mentioned 35 mm slides.

Within the 20 final sources, one was solely about the physical preservation of 35 mm slides, and three discussed physical preservation methods of 35 mm slides in addition to other types of photography (Figure 2). Out of these four sources, one was an article that was not from a peer-reviewed journal and three were physical books. There were no articles from peer-reviewed journals that focused on or mentioned physical preservation methods for 35 mm slides found within the search limitations and methods within this study.

R3. What sources from 1980-2021 on physical preservation methods for photography can be applied to the physical preservation of 35 mm slides?

Twenty sources were found and made it to the final selection in this study. Out of these 20, one was solely about the physical preservation of 35 mm slides and not on any other type of photography. The rest either contained information about the physical preservation of 35mm slides along with preservation methods of other types of material or contained information that can be applied to the physical preservation of 35 mm slides. Nineteen of the 20 sources fell under this research question. Out of the 19 sources, four were books, one was an article, and the 14 others were web-based sources (Figure 3). Peer-reviewed articles were found, however, further analysis of their content eliminated from the final results of this study.
**Figure 2:** Sources by how much Information is included on 35 mm Slides, n=20.

**Figure 3:** Number of Sources from 1980-2021 on Physical Preservation Methods for Photography, n=19.


**Articles**

The was only one article found within this study. “Preserve My Photographs” came from the Library of Congress Magazine’s fourth volume from 2015 (Fischer (Ed.)). It was made up of bullet points about what to do and not to do when handling or storing photographs. The little information it contained was overly broad and relatively simple. For example, the article mentioned to keep “food and drink away” from photographs and “have clean hands” when handling them (Fischer (Ed.), 2015, p. 22). This article was basically just general guidelines when it comes to caring for photographs.

**Books**

There was a total of four books related to this study based on its methodology and limitations. Three of these books also fell under the second research question since they contained a section or sections that referenced physical preservation methods for 35 mm slides.

*Photographs: Archival Care and Management* by Mary Lynn Ritzenthaler and Diane Vogt-O’Connor covered a wide range of topics when it comes to the preservation of photographs and their management within archival settings (2006). This book contained a great deal of information relating to the physical preservation of photographs. Ritzenthaler and Vogt-O’Connor (2006) covered causes of deterioration, storage, and handling of photographs. Additionally, it has a specific section that covered mold and mildew deterioration in detail (Ritzenthaler & Vogt-O’Connor, 2006).

*The Permanence and Care of Color Photographs: Traditional and Digital Color Prints, Color Negatives, Slides, and Motion Pictures* by Henry Wilhelm and Carol Brower focused solely on the preservation, conservation, and care of color photography (1993). Their book covered the different types of physical color photography, the various types of deterioration, how to prevent deterioration and further deterioration, and preferred display, handling, and storage techniques. As mentioned in the results of research question two, this book also contained two chapters that focused more on the physical preservation of 35 mm slides. One was solely about 35 mm slides while the other titled “Handling and Preservation of Color Slide Collections” covered 35 mm slides and related materials (Wilhelm & Brower, 1993).

*Twentieth-Century Color Photographs Identification and Care* by Sylvie Pénichon (2013) focused on color photographs much like Wilhelm and Brower’s (1993) book; however, her focus was solely on color photography from the 20th century. Pénichon’s (2013) book covered the history of color photography, types of color processes and mediums, deterioration of color photographs, and preservation methods. She included 35 mm slides within the book as well as other photography types. With the deterioration and preservation methods, she did not single out 35 mm slides in their own section but grouped them together with transparencies and also with color photographs in general (2013).

*The Film Photography Handbook* by Marquardt and Andrae was more about processing and taking photographs in older formats such as 35 mm film and other odd-size formats (2019). It had information about the history of 35 mm slides but no direct physical preservation methods focusing solely on or referencing 35 mm slides. However, it did have a section where it discussed how to store negatives and prints in materials that pass the Photographic Activity (PAT) test (Marquardt & Andrae, 2019). Marquardt and Andrae’s (2019) book echoed most of the other sources about the general storage of photographic materials as a form of physical preservation.

**Web-based Sources**

The sources found through the National Parks Service’s Conserve O’ Grams were PDFs and part of a newsletter series. Since they were discovered through pdf links on the National Parks Service’s website, they were considered web-based sources. The sources found through the National Archives’ website were pieces of text on webpages, because of being on the internet these were considered web-based sources as well. There were 14 web-based sources found by this study.

**National Archives**

From the National Archives web pages on preservation for the public, five of the web-based sources the site contained fit with the research questions of this study. Out of the five, only one mentioned 35 mm slides. This was titled “What is the Best Way to Store Negatives and Transparencies?” (U.S. National Archives and Records Administration, 2017). It discussed storage preservation methods for 35 mm slides and other negatives and transparencies.
35 mm slides are a type of transparency due to their projectable see-through image. Since this article included physical preservation information both on 35 mm slides and other related photography, it fell under this research question as well as research question two.

“Tips for Handling Family Papers and Photographs” reflected much of what Library of Congress Magazine’s “Preserve My Photographs” discussed in their article about handling photographs (U.S. National Archives and Records Administration, 2019b; Fischer (Ed.), 2015). In addition, this source also referenced how to handle family papers (U.S. National Archives and Records Administration, 2019b). Much of the text was very similar or exactly the same wording since they are both from the same government.

“How to Preserve Family Archives (papers and photographs)” was unlike some of the other web-based sources from the National Archives (2021). This source was about mold or insect infections within archival materials. It briefly covered the topic of mold and insects while giving links to outside sources for more information. Even though it has basic information and links for further study, it still contained relevant information that could be used for the physical preservation of 35 mm slides (U.S. National Archives and Records Administration, 2021).

“Storing Family Papers and Photographs,” covered the storage of papers and photographs (U.S. National Archives and Records Administration, 2019a). This web-based source briefly discussed at what temperature and humidity items should be kept and how to store different types of materials. The National Archives also included images of what to do and not to do that show more than just one type of photograph or family paper. One of the examples showed deteriorating slides in plastic sleeves (U.S. National Archives and Records Administration, 2019a).

“Cold Storage Handling Guidelines for Photographs” may have been pulled from the National Archives’ plans and guidelines for cold storage used within their archive facilities. The source gave bullet points on handling photographs from cold storage. It did not mention 35 mm slides directly, but these guidelines could be adapted for their handling (Wagner, 1991).

National Parks Service’s Conserve O’ Grams
The National Parks Service publishes newsletter-style documents called Conserve O’ Grams about preservation and conservation within the archive and museum collections. Nine Conserve O’ Grams met the criteria for this study. The information could be applied to the physical preservation of 35 mm slides. These were considered web-based sources by this study since they were available via pdf files on the National Parks Service website.

“How to Select Gloves: An Overview for Collection Staff” from 2010, discussed the reasons behind wearing gloves while handling materials, what types of gloves should be worn for different types of situations, when gloves are not worn and why, and how to handle materials while wearing gloves. It included photographs of the types of materials discussed and it was applicable to the physical preservation of 35 mm slides. According to this source, one way of preventing further damage to photographs is proper handling and wearing gloves to prevent damage from oils and fingerprints (National Park Service, 2010).

“Mold: Prevention of Growth in Museum Collections” went into more detail than the National Archive’s web-based source on the same topic (National Park Service, 2007). This source did not fully cover the subject but went into enough general detail that it provided more insight into removal techniques and information on the prevention and removal of mold (National Park Service, 2007). This source discussed types of molds that can be found on 35 mm slides and how to remove them just as Caldararo and Griggs’ (2001) article, but in addition, this source looked at all types of archival and museum materials.

“Storage Enclosures for Photographic Prints and Negatives” and “Buffered and Unbuffered Storage Materials” were both Conserve O’ Grams that discussed storage materials, practices, and guidelines for making sure items stored for long-term preservation have the correct storage options chosen for them (National Park Service, 1993; 1995). These two web-based sources worked together to fall under the results of this study and this research question. “Storage Enclosures for Photographic Prints and Negatives” had information about how to store various types of photographs, what types of storage are available, and the preferred types to use. “Buffered and Unbuffered Storage Materials” discussed the
physical qualities and materials within archival storage options (National Park Service, 1995). “Buffered and Unbuffered Storage Materials” also discussed what the terms buffered and unbuffered mean when it comes to archival storage supplies (National Park Service, 1995). Buffered storage supplies have added substances to absorb acidic chemicals that the materials give off as they age. Unbuffered storage options are made from pH-neutral materials (National Park Service, 1995).

“Caring for Photographs: General Guidelines” was an overview of preservation methods for photographs (National Park Service, 1997). As another source of generic information on preserving photographs, its information could be adapted for the physical preservation of 35 mm slides. The same went for the “Caring for Color Photographs” Conserve O’ Gram (National Park Service, 1998). This source focused solely on color photographs and contained general information on the preservation of color photographs. It also had information on certain types of color processes used to make color photographs (National Park Service, 1998).

“Cold Storage for Photograph Collections: An Overview,” “Cold Storage for Photograph Collections: Using individual Freezer Units,” and “Cold Storage for Photograph Collections: Vapor-Proof Packaging,” are all Conserve O’ Grams which focused on cold storage of various types of photographs, papers, books, and other archive or museum items (National Park Service, 2009a; 2009b; 2009c). These Conserve O’ Grams did not mention 35 mm slides specifically, however, their information regarding cold storage for photographs could be applied to the physical preservation of 35 mm slides.

R4. What standards or methods of physical preservation are there for 35 mm slide photographs?
Physical preservation standards or methods of 35 mm slides can be divided into three main groups: handling, deterioration, and storage. In the 20 sources found by this study, there were some methods of physical preservation that were directed specifically to 35 mm slides, however, the majority of methods found were either for photographs in general or specific for transparencies. The next three subsections are divided into the three main groups that the methods and standards fell under.

Handling
Handling photographs or 35 mm slides in the correct manner is the first line of defense against further deterioration of the item’s condition. Starting with the workspace one would be using to work with 35 mm slides, it needs to be clean and uncluttered (National Park Service, 1997). This requires that food, drinks, dirt, hazardous materials, cleaning chemicals, smoking, or vaping, poor air quality, and other substances that could harm the slides not be present in the workspace (Ritzenthaler & Vogt-O’Connor, 2006; National Park Service, 1997; U.S. National Archives and Records Administration, 2019b). Simply having a designated workspace that is clean is one of the first and one of the easiest ways to preserve 35 mm slides.

Another way to protect slides from further damage is to use clean hands or gloves when handling the slides (Fischer (Ed.), 2015). This entails making sure one’s hands are washed with soap to remove excess oil and are lotion-free. One of the most common mistakes that can cause 35 mm slides to be ruined is human fingerprints (U.S. National Archives and Records Administration, 2019b). Even with clean hands, if one touches the slide’s image, the oils from the human skin can cause a reaction with the transparency and over the image, there will be the culprit’s fingerprint (Ritzenthaler & Vogt-O’Connor, 2006). Wearing gloves does help if one slips up and touches the image a fingerprint would not be left. Many of the sources found in this study suggest white cotton gloves when handling photographs and 35 mm slides (National Park Service, 2010).

According to the Conserve O’ Gram on the topic of gloves, gloves protect both the wear and the object they are handling (National Park Service, 2010). Gloves are highly recommended. However, if wearing gloves either can damage the object or cause the wearer to have not enough sensitivity of handling that is required when working with an object then they should not be worn. If gloves are not worn, hands must be clean and dry when working with an object. This source also mentioned, if one is handling multiple objects without gloves then one should wash their hands between handling the objects to prevent the transfer of substances between the objects (National Park Service, 2010). Another pro about wearing gloves while handling slides or other objects is that it protects the wearer from allergic reactions and minor scrapes. If one is allergic to any of the materials on the object wearing gloves will help
When choosing the correct gloves, it is important to pick gloves that are clean, the right size for one’s hands, the correct thickness, and not made from materials that can harm the object or wearer. Materials like rubber or latex can cause allergies to the wearer and might “leave residues that can be deposited on objects” (National Park Service, 2010, p. 2). This is why white cotton gloves are preferred. The reason white is preferred is that it does not contain any dyes that can transfer to the object the wearer is handling. Not to mention, white gloves will show any sign of dirt or dust that gets picked up on the glove allowing the wearer to see how clean the gloves truly are (National Park Service, 2010).

Having a clean workspace, clean hands or wearing cotton gloves while handling slides, and holding the 35 mm slide correctly when working with them are the basic and easiest methods to assist in their physical preservation. When handling 35 mm slides that are housed within a frame/ mount only touch the frame/ mount, never touch the transparency itself. If the 35 mm slide is not housed in the frame and is just the piece of the film itself, hold it by the edges of the film away from the image (Image 1) (Ritzenthaler & Vogt-O’Connor, 2006).

Image 1: Clean Hand holding a 35 mm Slide by Its Frame/Mount (Meier, 2023).

Deterioration
With 35 mm slides, there are several types of deterioration that can affect them. Each type of deterioration has its own methods of treating or preventing further deterioration. Common types of deterioration for 35 mm slides are dye fading, fungi, and abrasions (Wilhelm & Brower, 1993; Ritzenthaler & Vogt-O’Connor, 2006).

Dye fading is when one or more colors in an image start to fade due to numerous reasons. There are several types of dye fading. Light fading is caused by the slide being exposed to UV radiation for long periods of time (Pénichon, 2013). This usually happens due to being projected with the light of the projector causing the slide to be exposed to UV light or if it is displayed on a lightbox or in a space where UV radiation can reach it. Wilhelm and Brower’s (1993) chapter on projector-caused fading mentions that light is the primary cause of fading during projection, not heat as most would think. Light fading is usually noticeable since it “characteristically results in a partial or total loss of highlights and low-density details and color shifts most visible in the low and medium-density areas of the image” (Pénichon, 2013, p.188). Depending on the 35 mm film brand, color processes, and development processes used will determine how long it will take a slide to be affected by UV radiation (Wilhelm & Brower, 1993). Usually, it is the magenta dye that would fade first in light fading, causing more of a yellow look, according to Wilhelm and Brower’s (1993) test they conducted. One of the worse films was Kodak’s Kodachrome Film (Wilhelm & Brower, 1993). To prevent this type of fading, limit projection time and keep slides away from UV lights. If constant viewing of the slide is required making a copy is preferred to keep the original from deteriorating more (Wilhelm & Brower, 1993).

Pénichon (2013) mentioned Kodachrome in her book as well but in relation to dark fading or thermal aging. Dark fading is where instead of light causing the fading, it is the temperature and relative humidity (RH) which cause the loss of the cyan dye leaving reddish images. Pre-1938 Kodachrome 35 mm slides have poor dye stability making dark fading a common occurrence, however, later versions of Kodachrome slides that have added couplers to their photographic development processes are much stabler against dark fading. To prevent or limit this type of deterioration...
keep slides in low RH and cool temperatures or even in cold storage environments (Pénichon, 2013).

Fungi, which can manifest as mold and mildew, are a threat to the 35 mm slide. Mold is usually the fuzzy growth caused by fungi (National Park Service, 2007). Mold and fungi on slides can appear in different ways. One way is on the frame/mount of the slide. Paper or cardboard mounts that have been water damaged and in warm humid environments or just warm humid environments, in general, can easily grow mold. The mold can destroy the information on the slide mount/frame or eventually damage the slide itself. Not to mention, if stored with other slides it can easily spread to them. According to Caldararo and Griggs’ (2001) article on the study of mold removal, mold can appear on the emulsion side of the slide. Their study showed that mold can be removed by dusting with a soft brush as one option. But this option had downsides. The fungi did not always come away and could scratch the emulsion. Their best method was freezing the slide at freezing or sub-freezing temperatures and when brought to room temperature moisture would appear, and with a cotton swab the mold and fungi could be removed with minor damage to the emulsion (Caldararo & Griggs, 2001).

35 mm slides, just like any other physical photograph, can be harmed by abrasions such as dirt, dust, and human fingerprints. Dirt and dust can scratch the slide destroying parts of the image. Dirt and dust can come from the air as well as from human hands and the workspace that the slide is handled in. To clean off dirt and dust without damaging the slide can be done in two ways according to Ritzenthaler and Vogt-O’Connor (2006). Before starting it is important to examine the slide first to see if it can withstand being dusted. If it is determined that it can be dusted, the first way is to use a soft brush to brush away the contaminants. Suggested brushes are camel’s hair photographic negative brushes or soft Oriental brushes that have light-colored bristles. Having a light-colored brush much like wearing white cotton gloves allows one to see when dirt and dust are picked up by the brush. Do not forget to always use a clean brush. The other method is to use an air bulb to blow away the dust (Ritzenthaler & Vogt-O’Connor, 2006). Fingerprints were mentioned within sources found as types of abrasions. However, the solutions given were not for the removal of them but the prevention. By handling a slide with gloves or clean hands and holding it by the edges or frame/mount and not touching the image will prevent fingerprints (Ritzenthaler & Vogt-O’Connor, 2006).

**Storage**

How an object is stored will determine how well it will be preserved. When it comes to storing 35 mm slides many factors come into play. Within the sources, this study found there were both specific and genetic methods and standards related to storing 35 mm slides. Starting with the space where the slides will be stored, the location must not be prone to excessive dampness, heat, and fluctuation of temperature and/or humidity (U.S. National Archives and Records Administration, 2019a). The National Archive mentions that damp basements, garages, and hot attics are not ideal locations for storing photographs or family papers. According to the International Standards Organization (ISO) the recommended ideal temperature and relative humidity (RH) for storing photographic film, which 35 mm slides fall under, is a wide range. The max RH should not be more the 50 percent. Depending on the RH the corresponding required temperature also changes. RH that is 60 percent or above will promote fungus growth, while RH below 15 percent can cause the film or photo to become dry and brittle (Pénichon, 2013). See Table 1 for the suggested RH and temperatures.

**Table 1:** Relative Humidity (RH) and Corresponding Temperature from the International Standards Organization (ISO) (Pénichon, 2013).

<table>
<thead>
<tr>
<th>Relative Humidity (RH)</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>50%</td>
<td>14°F or lower</td>
</tr>
<tr>
<td>40%</td>
<td>27°F or lower</td>
</tr>
<tr>
<td>30% or less</td>
<td>36°F or lower</td>
</tr>
</tbody>
</table>

It is also important to keep slides away from possible sources of leaks or flooding. If there are known leaks or pipes near the location where the slides are stored or planned to be stored, another location would be a better option. Water damage can lead to mold which then leads to the deterioration of the slides. The same goes if the slides are or are planned to be stored close to the floor of a location. By being on the floor or very close to the floor it only takes one flood to ruin the slides. It is preferred the 35 mm slides be stored on a shelf that is high enough to not get wet from possible
flooding. Along the same thread food and 35 mm slides should not share the same space since food and water can attract insects and rodents (U.S. National Archives and Records Administration, 2019a).

Storage materials for 35 mm slides as well as other photographic items can be made out of several different types of materials. The standards and methods for storing 35 mm slides and other related photograph items that the sources found within this study cover what materials are acceptable, which are not, and the pros and cons of the preferred materials. When it comes to selecting what type of storage container the 35 mm slides will be stored in and what it is made out of is especially important.

Depending on what type of object, one will store within the container will determine if the material the container is made out if buffered or unbuffered. Most archival-safe storage containers are made from pH-neutral materials. To be considered pH-neutral the material must read a 7 on the pH scale and would be considered an unbuffered material. This means that the container's material is not acidic (National Park Service, 1993). Photographs and 35 mm slides being stored within a container that is not pH-neutral can cause damage to them. The acidic nature of pH levels lower than 7 in materials used can cause acids to damage the photos. There are times when buffered materials are needed to store photographs and film. This is the case with types of photos and film which as they age release chemicals and acids that need to be absorbed to prevent damage to them. Buffered materials usually contain added materials of alkaline nature making the container’s materials register at an approximate pH level of 8.5 which will negate the acid levels when the object being stored emits acids (National Park Service, 1993).

When selecting containers in which to house 35 mm slides and other photographs, labels that claim the container is made from acid-free materials are not always the best choice. Containers and materials that pass the Photographic Activity Test (PAT) are the preferred and best types to store 35 mm slides and photographs in (National Park Service, 1993). PAT is an international standard test from ISO, that “explores the possibility of chemical interactions between photographs and a given material after prolonged contact” (Image Permanence Institute, n.d., para. 1). Materials, to be considered photo-safe, need to pass the PAT. To pass means that the material of the container or enclosure that is interacting with the photograph does not harm the photograph or create unwanted chemical interactions. If something is just acid-free and not PAT, then it is either not photo-safe or was not tested. It is important when choosing storage containers and materials that they pass the PAT (National Park Service, 1993).

Once finding storage materials and containers that pass the PAT consider what type of container is the best for one’s situation. Paper containers protect slides from light, are porous, easy to write on, and usually less expensive than plastic containers (National Park Service, 1993). Keep in mind if choosing a paper container or enclosure it needs to pass the PAT, be lignin-free, and not overly dyed. When it comes to dyed or colored containers avoid ones with a lot of dye or vibrant or deep colors like black since the dyes can transfer to the objects stored with the container (National Park Service, 1993). Paper is a good option for storage enclosures and containers, but its porous nature can be a downside when it comes to water damage. Since paper can easily retain water and allow for mold growth in the correct conditions, it might not be the best option. Also, since one cannot view a slide within a paper enclosure due to it not being see-through, the slide can be damaged in the removal process from the container if it is a slide viewed often (National Park Service, 1993).

Plastic storage enclosures and containers which pass the PAT and are of archival quality, are an alternative to paper. Not all types of plastic pass the PAT and are safe for photographs or slides. Archival quality polyester, polypropylene, or polyethylene that do not contain or are coated in plasticizers or any other substances and do not have any additives are preferred (National Park Service, 1993). Polyester is usually the most expensive of the three as well as the most rigid. It is known for creating static electricity that attracts dust which is not ideal. The second type, polypropylene, can be just as rigid if in a sleeve format style of enclosure as polyester. However, in other formats such as binder storage pages, it is less rigid and considered soft. The softest and most scratchable of the three is polyethylene (National Park Service, 1993). Polyvinyl chloride or PVC plastics are not acceptable for the storage of photographs according to several of the sources. The Conserve O’ Gram’s “Storage Enclosures for Photographic Prints and Negatives” points out that these types of PVCs, also called vinyl, are “not chemically stable and will
cause deterioration of photograph[s] over time” (National Park Service, 1993, p.2). Plastic containers and enclosures should only be used if the location of where the slides are being stored is in a climatically controlled environment. Due to plastic not being porous as paper, it can and will trap moisture which can lead to damage to the slide, and within the right environment encourage the growth of mold. Also due to the lack of breathability of plastics, being enclosed in plastic can cause any gases that the item gives off as it ages to become trapped and accelerate the deterioration of the item (National Park Service, 1993). This does not necessarily pertain to 35 mm slides since they are not usually made from film that would give off such gases as they age. On the other side of lacking breathability, plastic enclosures can protect photographs and slides from the outside environment and can prolong their life. When it comes to picking plastic storage enclosures avoid matte or frosted surfaces since they can harm the photographs and slides’ emulsion by scratching it and damaging the image (National Park Service, 1993).

Storing slides will ultimately depend on the number, condition, needs, and supplies available. Slides can be stored in paper or plastic containers and enclosures that pass the PAT. These containers and enclosures can be boxes and storage systems, which are made up of boxes, folders, etc. that work together, or plastic slide pages that work with ringed binders. Do not use original, older boxes or enclosures that came with the slides since they most likely would not pass the PAT and are either known to be unsafe for or it is not known if the material is safe for long term storage (U.S. National Archives and Records Administration, 2017). Ritzenthaler and Vogt-O’Connor (2006) suggest enclosures with custom-sized pockets which will fit the 35 mm slides and completely enclose them. This will provide the most protection since open-style enclosures make it easier for slides to fall out and become damaged. One does not have to remove the mount/frame from around the slide to store it. According to Ritzenthaler and Vogt-O’Connor (2006), it will not harm the slide. However, if the mount/frame is deteriorating or can pose a threat to the image, i.e., rust, mold, etc., it should be removed only if it will not damage the slide further (Ritzenthaler and Vogt-O’Connor, 2006). The best storage container or enclosure will depend on many factors, it will require the one who is working those slides to know what condition each slide is in, how often the slides will be viewed, what is the storage supply budget, and what will work best for the environment the slides will be stored in. Slides with color fading due to light would be better in enclosures that do not allow light in. On the other hand, if the slides are in fine shape and are to be viewed often putting them in binder pages could be the way to go. All would do best being stored in a cool and dry environment. There are some slides that would survive better in a cold storage environment due to their condition and deterioration (U.S. National Archives and Records Administration, 2019a).

Cold Storage is when items are stored at cold and cool temperatures to prolong their life. In the Conserve O’ Grams, there are three of them on this topic. These sources refer to cool as “55-65˚F with an RH of 30~40%” and cold is below 55˚F and could even hit 0˚F (National Park Service, 2009a). Cold storage is a helpful form of storage for slides that are in a fast deterioration state which can be slowed or stopped by cold temperatures and low RH. As “Cold Storage for Photograph Collections - an Overview” (2009a) mentions “any decrease in storage temperature below ambient conditions improves the longevity of vulnerable materials” (National Park Service, p.1 ). This is reinforced by scientific research from Image Permanence Institute (IPI) and other conservation professionals who have confirmed that color dye stability in film and photographs increases (National Park Service, 2009a). It is mentioned within the source that slides are one of the types of photographs that benefit the most from below-freezing temperatures. Cold storage is a great method of physical preservation by being able to almost stop time for a 35 mm slide. IPI’s table from “Cold Storage for Photograph Collections - an Overview” (2009a) which is replicated in Table 2 shows how based on average film deterioration rates how by temperature and RH will extend the life of film put into cold storage (National Park Service).
Other storage standards or methods to follow when trying to physically preserve 35 mm slides or photographic items that were found within the sources discovered within this study were to avoid using paper clips and staples that are not stainless steel, tape, rubber bands, and poor-quality glue, i.e., white glue, hot glue, or rubber cement (U.S. National Archives and Records Administration, 2019a). With slides, you could write on the mounts/frames. With cardboard and paper mounts/frames, pencil was preferred. Plastic mounts/frames using permanent markers could work, however, the suggestion was to test a small section before diving into labeling, and with permanent markers to make sure they do not rub off onto other surfaces (Ritzenthaler & Vogt-O’Connor, 2006).

DISCUSSION
This study looked at the physical preservation of 35 mm slides and related physical preservation methods and standards that were related to photography. Unlike most of the sources within the literature review section digital preservation was not considered. This study did not acknowledge digitization as preservation since the creation of a digital copy is not necessarily preserving the original. Both Burns’ (2017) and Conway's (2014) articles bring up that a digital version of a 35 mm slide is not the original since the digital form is not the same medium as the original nor the original itself, thus making the digital version a copy or surrogate of the original. VanSnick and Ntanos’ (2018) article did mention the point that digitization can be a type of preventative care when the original item should not be handled due to becoming further deteriorated. With light fading and dark fading, handling 35 mm slides could further deteriorate the images. Digitization could assist with being able to view the image the slide contains without harming it further. The Conserve O’ Gram about the general overview of cold storage pointed out that even though digitization may be a good option, it could be time-consuming due to various reasons like backlog, the need to acquire the digitization device, etc., which the item might not have the time to spare (2009). The source suggested putting the item in cold storage and then removing it from the cold storage when ready to digitize (National Park Service, 2009a).

Accessibility was another pro for digitization, that the sources in the literature review brought up. Bellacosa’s (2010), and Jerido, Cotilla, and Whitehead’s (2001) articles emphasized how access was the driving force behind digitization. This study was not looking at access in comparison to physical preservation methods of 35 mm slides. The focus was on the methods and standards to physically preserve the slide and prevent further deterioration. However, if a slide needs to be viewed and is not too deteriorated it can be stored in an archival enclosure made from PAT-approved archival quality plastics. Plastic slide pages with work with ringed binders could be an option (U.S. National Archives and Records Administration, 2017). Another option is to create a duplicate slide from the original according to Wilhelm and Brower (1993) to prevent further damage to the original from viewing. This is much like creating a digital copy but instead in the same medium as the original. Wilhelm and Brower’s (1993) book is from 30 years ago and with current technology it would be easier and more price efficient to create a digital copy of a 35 mm slide.

The three studies that this study references for its methodology did not actually deal with 35 mm slides, preservation, photography, or archival topics. They were picked based on their methodologies and types

<table>
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<th>Temperature</th>
<th>Relative Humidity (RH)</th>
<th>Years to Significant Change</th>
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<td>30%</td>
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</tr>
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<td>30%</td>
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</tr>
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<td>50%</td>
<td>625</td>
</tr>
<tr>
<td>32°F</td>
<td>30%</td>
<td>1170</td>
</tr>
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<td>10°F</td>
<td>30-50%</td>
<td>&gt;3700</td>
</tr>
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</table>
of studies. Faulkner, Klock, and Gale’s (2002) study was based on conducting qualitative research in regard to family therapy publications. This study was looking not for just how many sources there were on physical preservation on or related to 35 mm slides, but on what the sources found actually contained it is similar to Faulkner, Klock, & Gale’s (2002). As in their study, this study looked further at the sources it initially found to eliminate any that did not fit with it. This decreased the number of sources from the initial run-through to the final selection such as Faulkner, Klock, and Gale’s 2002 article.

Uzunboylu and Genc’s (2017) study’s was similar in style to Faulkner, Klock, and Gale’s (2002) and this one since it looks at the content of the sources pulled not just the number of sources found. Unlike this study, Uzunboylu and Genc’s (2017) study’s only focused on one database to pull their results and information from. For their study, it made sense because they were focusing on that specific database’s catalog of information to analyze what it contained (Uzunboylu & Genc, 2017). For this study it did not make sense to limit to just one database or catalog. That would have limited the outcome of this study and possibly make it useless.

Rinto, Bowles-Terry, and Santos’ (2016) study has similarities with the previous two and this study. The main similarity like the other further analysis of the found sources was required in their study. Their study was looking at first-year student research papers and their content. They were looking at common themes within those papers (2016). This study did not necessarily look for common themes or information between sources, but it was discovered, nonetheless. Several of the sources found within this study share similar information, methods, and standards or referenced each other.

Some of the most repeated or common information between the sources this study found were more common sense or overview style methods and standards. The majority was with handling 35 mm slides and photographs. The suggestion to wear clean cotton gloves was noted in all four of the book-type sources, “Tips for Handling Family Papers and Photographs” (2019), Conserve O’ Grams sources from the National Park Service titled “How to Select Gloves: An Overview for Collections Staff” (2010) and “Caring for Photographs: General Guidelines” (1998), and “Preserve My Photographs” (Fischer (Ed.), 2015). Another in terms of handling was having a clean workspace. Again, the four book-type sources mentioned this as well as U.S. National Archives and Records Administration’s “Tips for Handling Family Papers and Photographs” (2019), National Park Service’s “Caring for Photographs: General Guidelines” (1998), and “Preserve My Photographs” (Fischer (Ed.), 2015). Storage locations and the preference for a cold dry place were mentioned across almost all the sources. What varied was how much detail the source went into. The mention of ISO’s RH and temperature standards were mentioned in Pénichon’s (2013), Wilhelm and Brower’s (1993), and Ritzenthaler and Vogt-O’Connor’s (2006) books, as well as in several of the Conserve O’ Grams (National Park Service, 1997; 1998; 2007).

Types of dye fading was really limited to Pénichon’s (2013), Wilhelm and Brower’s (1993), and Ritzenthaler and Vogt-O’Connor’s (2006) books. These sources held the most information on what the types of fading are and the methods of prevention. The “Cold Storage for Photographic: An Overview” does mention dye fading but that is in response to how cold storage assists in slowing and stopping certain types of dye fading (National Park Service, 2009a).

When reading the final sources within this study some of the sources make references and refer to each other. It was observed that it was the book sources that referenced other sources that were in this study. Twentieth-Century Color Photographs by Pénichon (2013) references information and methods from Wilhelm and Brower’s (1993) book. The same goes for Ritzenthaler and Vogt-O’Connor’s (2006) book they reference Wilhelm and Brower (1993) as well. It was observed that none of the articles or web-based sources referenced the book sources or each other.

**CONCLUSION**

This study did not cover every method or standard on the physical preservation of 35 mm slides. Future studies on this topic could include widening the pool of information to be searched. This could include looking at more web-based resources or other databases. This study’s scope was limited to only two web-based sources, a selection of databases, and two library catalogs. It could be of value to include several types of library catalogs to expand the amount of possible book sources.
Another suggestion for future study would be to narrow the scope. Focusing on one aspect of physical preservation or one type of deterioration could produce more informative and detailed results. This study only looked briefly at cold storage for 35 mm slides. A future study could explore this further. Another study could look at the specific types of deterioration of polaroid 35 mm slides and their specialized preservation requirements due to their type of film process. Digitization was also not included as a method of physical preservation within this study as it was not considered a type of physical preservation. However, a future study that looks at how digitization could prevent deterioration of the original 35 mm slide could also be explored.

35 mm slides are just tiny little transparencies that contain images full of history. Because they hold pieces of family, local, and even world history, it is no wonder why physical preservation of these small items are important. From handling and storing them properly to being aware of the dye fading and possible fungi deterioration conditions, it is important to protect the original 35 mm slides. There is no way to prevent a slide from eventually degrading. However, knowing the basics and possibly more could make a 35 mm slide have a longer life.

REFERENCES


Meier, J. (2023). *Clean hand holding a 35 mm slide by its frame/mount [Photograph].*


