Defensible Collections: Designing a Safe Exhibit Space

Jeffrey Hirsch1 and Casey Gallagher2

Abstract
A startling number of conservators tell stories about mistreatment of collection material by the public. We used to hear a familiar type of problem: vitrines marred by strollers, glass broken by resting parents, or a pencil falling out of a pocket onto a background. Now, the story is more dramatic: French fries deposited on remote surfaces of large dinosaur specimens. Is an exhibit successful if attendance contributes to the damage of delicate material? This paper provides a broad overview of the risk to exhibited collection material imposed by visitors. Patterns of damage to collections correspond to specific characteristics of the exhibit spaces themselves. This investigation looks at problems encountered at one large paleontology exhibit and overlays successful concepts drawn from sources outside the museum world.

Keywords
museum, subject focus, collections care, case study, collections management, preventive care, risk analysis, visitor studies

Background
This article was originally published in “Collection Forum” in 2013 while we, the authors, were designing the renovation of the David H. Koch Hall of Fossils at the Smithsonian’s National Museum of Natural History (NMNH). Early in that eight-year project, we learned about the condition of specimens that had been on open display, and we saw that collection care professionals were reluctant to discuss any mistreatment of cultural heritage by visitors. We realized they were pinned between their obligations to preserve and also share collection material with the public, so we decided to explore the issue out of concern and without the same professional angst, as architects

1Hirsch Culture Works LLC, Melrose Park, PA, USA
2EwingCole, Philadelphia, PA, USA

Corresponding Author:
Jeffrey Hirsch, Principal, Hirsch Culture Works LLC, 1113 Stratford Ave, Melrose Park, PA 19027, USA.
Email: jeff@hirschcultureworks.com
and designers. Understanding how the public display of collections affects the mission of preserving these collections is the focus of this narrative.

In 2019 we eagerly joined with colleagues in the Promoting Exhibit Access and Safety (PEAS) Working Group to study this problem from multiple perspectives across the larger museum/archive/historic place milieu. The Working Group tracks data collected from colleagues, analyzes the problem and makes recommendations based on evidence of success from around the world.

The additional research from the Working Group points to the continuing influence of three of the ideas from our original publication:

- **Nudges**
  Security systems are fallible, expensive and can inhibit positive visitor interactions with collection material. Solutions that suggest or imply appropriate behavior are more likely to be successful.

- **Communication**
  Signs that have direct language are effective (most of the time), particularly when paired with rails, stanchions, or other subtle indications that tell people where they can safely be and where they should avoid.

- **Interdisciplinary solution**
  While we argued in 2013 that involving the public in the solution made sense, we probably should have focused on involving more people within an institution. Public behavior can be unpredictable, and the more people within an organization who try to discourage detrimental visitor interactions—the better.

Architects and exhibit designers have a unique opportunity to address these problems in design projects when galleries are shaped. We have a responsibility to acknowledge visitor behavior and anticipate certain reactions in our designs. We can also bring different perspectives to the design table when we organize meetings and workshops in the earliest phases of design. Visitor services, museum security, janitorial staff, educators, collections care staff, and others address this problem on a daily basis. The Working Group and these authors are convinced that an interdisciplinary approach is the best way to improve how people interact with exhibit material—in fact we feel more strongly about this solution than we do about how much we understand the problem.

**Description of Problem**

Despite reduced funding from public and private sources, the American Alliance of Museums (formerly the American Association of Museums) has reported increases in
attendance at museums in the wake of the global economic recession (American Association of Museums [AAM] 2011). Organizations often tout these statistics as evidence of success, and many seek to build upon this popularity with programs tailored for a newly expanded audience.

Yet as more visitors stream into museums, collections managers and conservators increasingly see a cost borne by material placed on exhibit. Rising attendance has been accompanied by an increase in damage to valuable artifacts, and both published reports and conversations with museum professionals indicate that the problem is getting worse (Drdacky and Galova 2002).

This paper focuses on a single exhibit, the David H. Koch Hall of Fossils at the Smithsonian Institution’s National Museum of Natural History (Fossil Hall), as a case study of damage to collections caused by visitors. As home to the Smithsonian’s paleontology collection, Fossil Hall is an iconic place in the cultural life of Washington, DC, and an eagerly anticipated part of many visits to the National Mall. The exhibition space has evolved over time; renovations have incrementally changed the gallery from the Beaux Arts space of its original construction to a collage of styles and interventions as of 2013 when the exhibit closed for a revitalization. At the time of our original writing, Fossil Hall included raised decks and platforms for displays, placed many specimens within reach of even small children, and sat alongside an informal food service venue called the “Fossil café.” This case study represents an extreme example of visitor behavior. Because it is a feature of one of the most visited museums in the world, Fossil Hall hosts more people and therefore confronts a dramatic range of behavior, both good and bad. At the same time, this example demonstrates what we have seen at many other museums (Russell 2012).

An unpublished assessment report of 75 out of 475 vertebrate specimens on display in this exhibit was completed in preparation for the recent renovation project (Hawks et al. 2010). The survey describes in detail (Figure 1) the state of the artifacts, some of which have been on continuous display since the museum opened in 1910, and the document provides a series of recommendations that shaped the 2013 renovation’s scope and timeline. Recommended conservation treatment measures relate directly to the age of the mounts, types of display techniques, and the fragility of the specimens themselves. The collection remains in remarkably good shape given its age and the number of visitors over the years, a testament to the museum’s safekeeping over several generations of stewardship.

Exhibit methodologies have a direct connection to observed damage. Artifacts on open display have twice as much mechanical damage and three times as much soil and dirt as material housed in cases or vitrines (Hawks et al. 2010). Specimens within reach of the public exhibit more damage than those mounted more remotely. The more accessible items show signs of being touched, and in some instances, pieces have been broken and removed. Even specimens mounted overhead have accumulated food residue such as ketchup and chewing gum.
How can this loss be prevented? Exhibiting at least portions of their collections is central to most museums, but so is the preservation of that same material. The public display of cultural heritage seems to be vulnerable to two types of negative interactions with visitors, which we refer to as active and passive damage.

**Active Damage**

Several specimens in Fossil Hall showed signs of damage that could not be accidental in nature:

- Food deposits, including pieces of French fries, candy and condiments
- Portions removed (items were taken as souvenirs)
- Discoloration from fingerprints
- Debris within display cases (coins)

The harm to collection material caused by willful behavior—through indifference or sometimes on purpose—is active damage. One might assume that this behavior would take place at the margins of the exhibit, out of sight of security guards and museum staff. These incidents might represent an act of opportunity presented by the individual design of the exhibit enclosure. Mapping the incidents, however, indicates
no particular pattern except that noticeable damage clusters around the pedestrian paths through the space. Villains (we are exaggerating) have not taken advantage of hidden corners or blind spots; most of the incidents were in the open. People seem to have acted without concern for the repercussions of their actions (Figures 2 and 3). One can conclude that wherever there are people, there is likely to be some incidence of damage to the collection.

This report looks to other fields that study behavior at different scales for solutions. A city, for example, has a compelling need for a certain sense of order. Although urban dwellers tolerate some control over their daily lives, they also expect easy and direct access to shared amenities such as parks, plazas, and sidewalks. Why do many urban spaces thrive even though they are vulnerable to crime and malfeasance? What prevents vandalism in public areas that are monitored to much less of a degree than are museums?

**Behavioral Determinants**

Museums are unlikely to consider their visitors to be criminals, yet exploring the causes of crime in the city (a larger scale than a museum) may give museums ideas for protecting their collections. The social sciences offer a variety of models for degenerative behavior, many bound deeply in politics and technical in their analysis of larger socioeconomic forces. This report looks at one example, drafted in 1982 for a general
audience, to see whether understanding how one analysis of the structure of urban decay can explain the underlying factors that contribute to indifference in museum visitors. The scale of the two problems is radically different, but at the root of both is the behavior of people in the public realm.

A seminal article in *The Atlantic*, “Broken Windows,” explains the importance of order and maintenance within the urban conscience. In the face of a dramatic growth in drug use and its related violence, the authors, Kelling and Wilson, suggest that the value of police activity is less about crime prevention and more about maintaining the informal mechanisms within neighborhoods that allow communities to control their environments. Successful communities monitor their spaces and address problems quickly and efficiently (Kelling and Wilson 1982). The familiar algorithm from this article identifies a broken window as a signifier that group controls have failed. People sense that no one cares, and the neighborhood begins to decline. Police departments lack the resources to replicate the system of controls present in a healthy and vibrant neighborhood; criminals understand this process all too well and take advantage (Kelling and Wilson 1982).

**Figure 3.** Instances of visitor damage (red dots) to collections range from disposing of trash to contact with specimens. Ironically, repeat damage is highly prevalent in the core of the space despite its high degree of visibility.
The relevance of this theory to our museum example is less its proposed policing model and more the way it looks to the group for a solution. Police watches are unnecessary if a community is functioning properly: families sitting on porches or stoops will report suspicious behavior early, find out what brings outsiders into the neighborhood, and handle nuisance activity quickly. Those closest to the problem are the best agents for correcting it. As an analogy to the vandalized exhibit, this model suggests that the museum audience can play an important role in helping to maintain orderliness. Visitors outnumber museum staff and are likely to be close by when incidents occur. Can they be asked or even taught to help safeguard a museum’s collections?

**Spatial Determinants**

Defensible Space. The failure of architects in designing multifamily housing (particularly in New York) in the 1950s and 1960s focused attention on the qualities of effective, secure buildings. The design community enlisted help from the social sciences to determine how safe, livable neighborhoods work. One set of answers came from a research team led by Oscar Newman. *Defensible Space* (Newman 1973) explains how the built environment suggests to both an inhabitant and a stranger that an area is under the undisputed influence of a particular group—that a place is controlled by its residents. Certain configurations of space favor the clandestine activities of the criminal, and designing successful places requires the establishment of a clear hierarchy between the public and the private (Figure 4).

Like the Broken Window theory, *Defensible Space* argues that policing is best done by the people in a community acting together. Spaces that cultivate safety and vitality include several important features:

- Symbolic barriers
- Defined areas of influence
- Improved opportunities for surveillance.

Our case study, Fossil Hall (Figure 5), sits along the main entrance to the museum from the National Mall; visitors have immediate access to the exhibit from a central Rotunda. The pattern of visitor circulation is clear and direct. Staff, however, have offices that are often remote from the exhibit space, and their movement from office to other work spaces generally avoids travel through Fossil Hall. If these patterns were to change so that staff had more interaction with the public, then *Defensible Space* would predict that incidents of vandalism would be reduced. Note that the incidents of vandalism are less frequent in immediate proximity to the FossiLab, a laboratory with windows that allow visitors to watch collections managers and trained volunteers work with collections.
The implication for museums involves organizing spaces around exhibits to bring the workday of the museum professional alongside the public and allow more interaction. Isolating exhibits can leave these spaces untended by staff other than those explicitly tasked with overseeing their goings-on.

*The Social Life of Small Urban Spaces.* The fact that most museums have security systems to protect valuable artifacts is well understood by the public, and yet some patrons treat the collection in ways that are clearly wrong. More obvious monitoring of visitors could further dissuade some unwanted behavior, but this strategy could also change the atmosphere of the institution. Is that response necessary? Daily life includes plenty of places where crime is not present, even though opportunities exist. Many cities have plazas where loose furniture is left overnight, where garbage collects in trash cans and not on the ground, and where things are quiet enough for people to read or even work outdoors for long periods of time. Examples are numerous: Market Square in Houston, Bryant Park in New York, cafes along almost every
boulevard in Paris. Why are some public places vibrant, orderly, and generally safe for visitors of all ages despite a lack of management?

One set of answers stems from research begun in the 1970s by a team of academics led by William H. Whyte. The group, now known as the Project for Public Spaces (PPS), observed places over long periods of time. Recording the subtle differences in the quality of street life around large cities, PPS identifies several qualities of successful places that are relevant to museums:

- They are largely self-policing.
- Places can be adapted by their audience (movable chairs and tables are key) to make the space most useful.
- Plazas connect directly to the street; from the pedestrian’s point of view the spaces are seamless.
- Street corners are significant places in the life of a city, where people meet, linger, and watch other people.
- Barriers such as fences or site walls along the street usually create problems for urban spaces, interrupting their connection to the city fabric (Whyte 1980).
PPS’ research suggests that the best way to reduce the likelihood of people disrupting the peace and quiet is to make a place attractive to everyone else. In city plazas, the solution includes providing amenities such as movable furniture that allow for impromptu meetings. These bring office workers outdoors and into plazas to enliven the space. Orienting plazas along the sidewalk allows activity to flow from the street, so the open space is vibrant whenever the street or sidewalk is active.

Comparisons with urban life are more fruitful for large museums like our case study. NMNH was designed with careful consideration of its place in the District of Columbia (Figure 6). It connects directly to the National Mall and to Constitution Avenue, continuing the pattern of pedestrian circulation into the building and toward the grand exhibits. The steps along the Mall and the adjacent Rotunda are lively spaces often filled with people, most of whom will visit Fossil Hall. If the museum were to solicit help from this population, it must provide amenities that encourage at least some people to remain in the galleries for a while. Designing places for people to pause within the exhibit, along the beaten path, ensures that someone will be in the space for more than a cursory visit and (maybe) keep an eye on things.
**Passive Damage**

People also represent a risk to the collection even if they do everything a museum professional wants of them. The innocuous harm we inflict on artifacts is passive damage, and this article focuses on two sources: vibration and dust.

**Vibrations**

The level of vibrations imposed on collections from sources such as vehicular traffic and mechanical equipment presents a risk of physical damage from many causes, including abrasion from mounts (if the object can move within a mount), displacement of objects from shelves or display equipment, and direct physical damage from a force (often called an “acceleration”) impacting an object. Renovation projects can be a time of heightened concern about vibrations if heavy equipment will be used in or near the building. Construction activity in one area can produce vibrations that transmit through the building’s structural frame and cause problems elsewhere. Institutions will often monitor vibration levels during construction and establish procedures for stopping work in order to limit the exposure of collection material to damage. Monitors trigger an alarm if work exceeds a threshold level, measured in terms of the force or acceleration (Watts et al. 2002). This practice has become fairly commonplace when museum professionals are involved in construction projects.

The most prevalent source of vibrations is visitor circulation through a gallery (Thickett 2002) (Figure 7). A person walking creates accelerations that typically peak at .15g (damage is reported to occur between .2g and .6g). The resulting deflection can vary widely depending on floor assemblies and other aspects of the building’s construction. Universal standards for allowable vibrations do not exist; requirements instead vary by collection and by institution. By anecdote, many museums have agreed upon limiting the daily exposure of objects to vibration levels of 3 millimeters per second (mmps) based on the construction referenced in Watts and Berry’s article (Smithsonian National Museum of American History 2008).

Increasing the number of pedestrians in a space has a direct relationship to the accelerations observed (Lloyd and Mullany 1994). Spikes in attendance amplify peak particle velocities within galleries and lead to an accumulated risk to collection material. House museums pose a particular challenge because these buildings have been typically designed for more lenient structural criteria than is used in the design of purpose-built museums. Since house museums are typically housed in older buildings, they have had more time for accumulated damage.
Visitors create the greatest amount of dust in a museum (Yoon and Brimblecombe 2001). Larger dust particles are typically composed of fibers from visitors’ clothing and hair. These particulates are most frequently deposited at the ground level and redistributed along circulation paths by people walking through the exhibit; dust levels fall off dramatically as the distance from visitors increases (Nightingale 2005). Dust is of significance because it can contain particles that can chemically react with collections, attract moisture which can accelerate degradation in some materials, and be a food source for pests. The cleaning required to remove dust is a moment of potential damage from abrasion (depending on the method of removal and the type of dust present) and from the required increase in handling. Although particulates of less than 10 μm in length and width may be a bigger concern to human health in the long term because they pass through the nose and throat and enter the lungs, larger visible particles are noteworthy because they can be managed by janitorial and collections staff and by filters in the building’s HVAC system (United States Environmental Protection Agency 2012).
The situation is complicated when an institution exhibits fragile material on open display. Dust distributed on exhibits may be more visible in the dimmed light often required in textile galleries, for example. Exhibit material in this situation would then need more frequent cleaning and result in further risk to the objects from that process (Nightingale 2005).

Both vibrations and dust point to people as a threat to collections without other mitigating factors. Methods for reducing the potential for dust damage involve regular cleaning of floors and other surfaces, routine changing of any filters and increasing the distance between the collection material and the public. The latter calls for careful consideration during the design of the exhibit in order to integrate collection management into its didactic theme. But separating fragile material from the public promises a more complete solution, since barriers (glass display cases, stanchions or rails and pedestals and elevated platforms) require no active maintenance to work.

Tools for Safekeeping Your Collection

Addressing the problem of damage caused by detrimental interactions questions the methods used to exhibit a collection. Passive damage relates more directly to display techniques and may be easier to solve if collection material can be taken out of open display or relocated at a distance from the public. Large specimens, however, may not be so easily rehoused, and exhibit components such as dioramas may be of significance in their own right and not readily altered.

Controlling or managing active damage requires a constant effort on the part of the museum—engaging museum patrons, reorganizing exhibit space and managing the flow and visibility of visitors. Exploring a few examples from our case study suggests ways of reducing risk to collection materials on display.

Boundaries

Most museums provide a variety of experiences that elicit different types of behavior from people. A gallery may be a place of quiet reflection; a cafe may be more spirited. Delineating their edges helps reinforce the appropriate etiquette in the different places.

A good deal of the damage cited in our case study’s assessment revolves around the food service venue that was immediately adjacent to Fossil Hall (Figure 8). This juxtaposition was extremely unpopular with collections staff (the cafe was removed in the recent renovation) as instances of damage frequently occurred nearby. Its design aggravated the problem by blending into the surrounding exhibit, sending an impossibly subtle message about where eating was acceptable and where it was not. The lack of both an identifiable entrance and exit to the cafe made it possible for people to misunderstand the extent of the food service venue. Garbage cans were hidden for
aesthetic reasons, so the public had to decode the interior design to understand where to dispose of trash.

Boundaries help reinforce the limits of certain kinds of behavior, and they are important as natural history museums seek to attract families with young children and first-time museum goers. Museums frequently offer tools such as maps to direct people through an unfamiliar venue. The posting of rules related to specimen care are far less common. Instead, most institutions rely on subtle messages regarding expectations of audience behavior to avoid offending people. Evidence suggests that museums need to communicate more clearly to help mitigate damage to collections.

**Clarify Signage**

Signage must play a more central role in the preservation of collection material. Our case study identifies the conundrum of subtlety—inviting people to handle portions of an exhibit can be interpreted as an open-ended opportunity. Museums need to be candid and direct about their expectations of how visitors should interact with the collection (and behave in general).

Language greatly influences the resulting behavior. A survey by Mt. Rainier National Park has tested several different types of signs within hundreds of miles of open trails. The first sign type states “off-trail hikers may be fined.” The second sign makes an ethical appeal sign by stating, “stay on paved trails and preserve the meadow.”

**Figure 8.** The Fossil Café is so highly integrated into the design of the exhibit that a clear entrance and exit cannot be distinguished. What does this say to the museum visitor?
Other signs included a symbol without text and a humorous message. While all signs were effective in reducing hiking off-trail, the first sign indicating “off-trail hikers may be fined” was by far the most effective, by nearly 25% (Johnson and Swearingen 1992). Though taking such a hard line may seem overly aggressive (and we do not suggest fining wayward visitors), careful consideration of the text is needed to protect the most precious specimens in a collection.

The problem of communication rises to a head when exhibits encourage the handling of objects alongside material that should not be touched (Figure 9). Examples include the display of replica textures and objects intended to give the audience a tactile sense of the artifacts encountered in the rest of the exhibit. Here the rules of behavior depend on a narrative because the physical distinction between “dos and don’ts” can be unclear. In our case study, signage describes what can be handled but (almost always) fails to indicate what should not be handled. The distinction should be more explicit since tactile exhibits provide access to exhibitions for many people including visually impaired visitors.
Acoustics

Spaces filled with people, particularly large tour groups or excited children, can be extremely loud. Perhaps the added volume is a necessary by-product of success. The public comes to your building and enjoys themselves—so what if there is a bit of noise? The problem is that the noise levels can change people’s behavior, and not usually for the better.

High sound levels make learning extremely difficult, reduce visit times, and change the aesthetic planned for the space (Shield, Greenland, and Dockrell 2010). This challenge is exacerbated at natural history museums because of the number of school visits the typical museum hosts, the average age of the visitors, and the tendency to mix media types (for example, it is OK to yell and scream during an IMAX movie but not in an exhibition hall).

Noise and aggression have a direct relationship—increasing ambient sound levels leads to more aggression in people who have been induced to anger. In response to noise, people will focus their attention and oversimplify their surroundings, distorting their perceptions of complex social relationships. The result is that increases in sound levels are concomitant with decreases in interpersonal sensitivity. People become less concerned with being polite and less sensitive and caring about their social situation (Cohen and Spacapan 1984).

Increased sound levels contribute to an environment where some people see no consequence in damaging public property. The noise does not create vandalism, but it makes people more likely to behave inappropriately. In our experience, art galleries are seldom as loud as our case study. Instances of vandalism in art museums do occur but are often of a different nature: people making a personal or political statement (Russell 2012). Reducing sound levels in natural history museums requires careful thought in their design and can be expensive to solve after the fact. Moreover, museums are social places where communities may expect to have a conversation about art, science, and history. Despite this, reducing sound levels should be considered as a means of influencing marginal behavior and protecting the collection without compromising access to collections.

Collection Display Methods

How the collection is presented to the public has a significant influence on its safekeeping. The conditions assessment of Fossil Hall indicates material stored in exhibit cases has fared better than items on open display; however, even the cases show signs of tampering as coins are occasionally found in vitrines. What appears to be the best indicator of collection safety is the distance of the object from the public.

The progression over time in the display of the model Stegosaurus in Figure 10 indicates a move away from a formal presentation of the artifact toward its placement
Figure 10. *Stegosaurus* model display through time at the National Museum of Natural History, Smithsonian Institution. Photographs by Smithsonian Institution.
within a composed environment. Located close to the public, the replica has been
damaged due to mishandling from being within reach of visitors.

Along with other, valid exhibition goals (e.g., connecting people to your collection,
outcome studies), exhibit design should consider the following (Nightingale 2005):

- Barriers around items on open display; the renovated Fossil Hall keeps objects
  at least three feet (92 cm) out of public reach
- Bases at least 30 cm high
- Positioning fragile items away from entrances and exits.

These suggestions are rooted in the goal of reducing exposure to dust and debris, yet
they also protect material from vandalism and require no active maintenance to work.

Early photographs of Fossil Hall show artifacts presented as sculpture on pedestals and
with adequate space alongside for circulation to accommodate large groups (Figure 11).
This arrangement satisfies many of the qualities of safety deemed important by Newman
in *Defensible Space*: clear views of the space allow museum staff to observe the activity,
while stanchions serve as symbolic barriers between the circulation space and collections. Finding a modern interpretation of this type of display would move some of the collection material on exhibit farther away from people—or at least the most fragile pieces. These design gestures require careful planning and some explanation to the public as to why certain material is displayed differently or at a distance.

Collection display methods should also take into consideration the need for routine maintenance. Vitrines and display cases protect specimens, but if the surrounding interior architecture inhibits access to the case for custodians, the area will not be cleaned on a regular basis. Trash and dust will eventually accumulate, providing a subtle cue that the area is not under control (a problem predicted by the Broken Window theory).

Conclusions

Seven million people visit the National Museum of Natural History a year, making it one of the most visited institutions in the world. If one person in 100,000 vandalizes an artifact, then the collection endures 70 annual incidents of damage. The actual rate could be much higher.

As more people visit museums each year, institutions must take reasonable action to protect their collection material. Our observation is that museums are well versed in preventing passive damage to collections, but the growing threat of vandalism and other forms of active damage has not been adequately addressed. We strongly suggest that institutions solicit help from their audiences in protecting collection material—via a clear dialogue about collection care, and by changing the way that exhibit spaces are organized to encourage appropriate public behavior.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Jeffrey Hirsch https://orcid.org/0009-0009-2982-7777

References


Author Biographies

Jeffrey Hirsch is an architect who helps museums and other cultural institutions explore how their built environments can enhance their missions and values. Jeff’s expertise includes gallery and exhibition spaces, public engagement and the preservation of cultural heritage.

Casey Gallagher is an accomplished architect, planner, and project manager with extensive experience guiding museums and cultural institutions through every stage of planning, design, and construction. Her dedication to understanding the influence of the built environment on its users has been cultivated through extensive collaboration with a wide array of organizations, spanning various scales and types.