



# Interpretive Panels for Geoheritage Sites: Guidelines for Design and Evaluation

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## Abstract

Effective interpretive panels go far beyond conveying information: they are highly engaging, instill passion, and inspire visitors to engage in environmental stewardship. This review paper on designing and evaluating interpretive panels at geoheritage sites shares recommendations gleaned from experts in conservation science, neuroscience, pedagogy, psychology, visual arts, and communication. It emphasizes the importance of developing a communication plan, knowing your audience, using strong visuals, invoking storytelling and active learning techniques, layering your message, being inclusive, choosing an appropriate panel location, integrating evaluation throughout the design process, and budgeting appropriately. An extensive reference list is provided for further reading.

**Keywords** Geoheritage · Geoconservation · Geoscience Education · Communication · Science Interpretation · Interpretive panels

## Introduction

*You cannot protect the environment unless you empower people, you inform them, and you help them understand that these resources are their own, that they must protect them.* Maathai (Climate Reality 2011)

Geoheritage is intimately linked to place (Reynard and Giusti 2018). Successful geoheritage sites communicate science in ways that both educate and engage visitors, and ultimately help preserve the site's history and culture. However, a great deal of planning is required to produce effective communication tools.

Self-guided interpretive panels (henceforth called “panels”) are a popular way to communicate science through the arts. Panels combine text and images to communicate a story about a location, object, or history. They have numerous advantages over guided interpretation: they can incorporate multiple languages, deliver information to a wide audience,

be freely viewed whenever the site is open, are not intimidating to visitors, and tend to be durable and cost-effective (Colquhoun 2005; Ham 2013). Thus, it is not surprising that panels are commonly found at geoheritage sites worldwide.

At the June 2018 IXth International ProGEO Symposium in Chęciny, Poland, there was considerable discussion about panels. During both poster and oral sessions, participants grappled with questions such as: *How can panels be most effectively used to communicate geoscience to a lay audience? How much information is too much to include? and How can panels be evaluated?* Reflection on these discussions led to this review paper, which shares recommendations gleaned from various disciplines, including geology, conservation science, neuroscience, pedagogy, psychology, visual arts, and communication. (Note: Due to the authors' limited language proficiency, we regret that we were only able to access information from English-language sources). Although the recommendations in this paper focus on panels at geoheritage sites, some may be broadly applicable to other types of communication products as well.

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## Developing a Communication Plan

*The chief aim of interpretation is not instruction, but provocation.* (Tilden 1957)



**Fig. 1** “Hunstanton’s Cliffs: Why are they Striped?” (England) A panel with this title was located in clear view of said cliffs. The location creates an immersive on-site experience, allowing visitors to engage with the striped cliffs. Photo copyright Thomas A. Hose (Hose and Vasiljević 2012), reprinted with permission

Designing a panel begins with developing a communication plan, which entails answering basic key questions, such as: *What is your objective?* *What is your message?* and *Who is your audience?* For example, many visitors to geoheritage sites may be primarily interested in recreation, as opposed to education, so communication materials should be developed with this audience in mind (Hose 2006). Numerous resources are available to help guide you in developing a communication plan (Hose 2006; Ham 2013; Paths for All 2014; Stradner 2009; Trapp et al. 2006). Establishing SMART objective(s) that are specific, measurable, assignable, realistic, and time-related (Doran 1981) will reap benefits later, as they readily lend themselves to evaluation (discussed below).

When developing your communication plan, be mindful of where your panel will be located. An appropriate location can facilitate understanding and reception of your message, while a poorly placed panel may frustrate or confuse your audience (Cross 2012; Moreira 2012). Care must be taken to place panels in a safe location that minimizes visitor disruption to sensitive or pristine areas, where foot traffic could cause adverse environmental impacts (Hose and Vasiljević 2012; Macadam 2018). Fig. 1 exemplifies how a well-chosen location can enhance your panel display.

## Writing Effective Text

*Dry words and dry facts... will not fire hearts.*  
(Muir 1896)

A strong panel goes far beyond simply providing information: it is highly engaging, communicates passion, and inspires action (Tilden 1957). Macadam (2018) describes interpretation as a dynamic and personal experience involving our heads (cognition), hearts (emotion), and hands (action).

Useful tips on writing interpretive text include write simply and concisely, use analogy or metaphor, speak directly to your audience with an active voice (e.g., tell a story in first person, or use the pronoun “you”), and incite curiosity and wonder (Colquhoun 2005; Scottish Natural Heritage 2017a; Veverka 1998). Aim to translate technical jargon into language accessible to a lay audience without “dumbing down” or distorting information (Ham 2013; Heath and Heath 2007; Hose 2012). Even commonly used words (e.g., hypothesis, theory, significant) may cause confusion if they are used differently by scientists (Ghose 2013).

Panels with fewer than 200 words will be read more carefully and by more people than longer labels (Macadam 2018; Scottish Natural Heritage 2017b; Trapp et al. 2006), hence the “3-30-3” rule, described in Fig. 2 below.

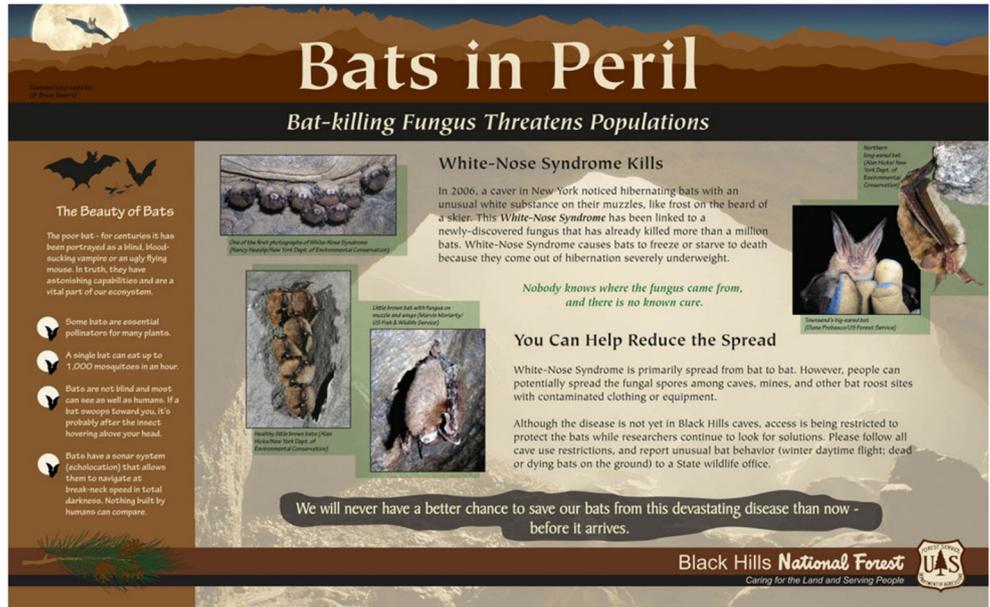
A case study at Ponta da Ferraria e Pico das Camarinhas (Portugal) found that 52% of 206 visitors looked at panels for less than a minute each (Lima et al. 2017), suggesting that, perhaps, a “3-30-1” guideline should replace the existing “3-30-3” rule. Another study at Iguassu Falls National Park (Brazil) found that, of the 300 visitors who completed a questionnaire, 67% did not read the panels they encountered (Moreira 2012). Reasons cited for not reading panels were primarily related to the text being excessive or overly technical. These studies and others (e.g., Garcia et al. 2017) stress the importance of aesthetics and using visuals as the primary medium to carry your message.

## Storytelling

*Writing is really a way of thinking – not just feeling but thinking about things that are disparate, unresolved, mysterious, problematic or just sweet.* (Morrison 1992)

Storytelling is particularly effective in panels, because stories communicate what might otherwise be perceived as uninspired, factual information in an entertaining, memorable, and evocative way (Denning 2005; Hillier et al. 2016; Ness 2007; Philips 2017). Duarte (2013a, 2013b) explains that “our bodies are hard-wired to both learn from and enjoy stories, especially stories of transformation: We feel a chill down our spine, our heart beats faster, and our eyes dilate so we can take more in. And, as we root for the hero to emerge victorious and transformed, we are changed in the process. Thus, we are not just observing transformations, but applying the lessons learned to transform ourselves.”

**Fig. 2** This panel illustrates the “3-30-3” rule (Trapp et al. 2006). The headline is written in large font, which visitors can read in 3 s. This key message is supported with a main image and medium-font subheadings that can be read in 30 s. Additional images and subtext can be absorbed in a total of 3 min. At no point would the viewer likely feel overwhelmed with text or clutter. “Bats in Peril,” Black Hills National Forest (USA). Image reprinted with permission from Black Hills National Forest



Story-based instruction with emotional content has been shown to improve motivation, initial understanding, and subsequent recall of the material, according to research in both neuroscience and psychology (Lin-Siegler et al. 2016; Zak 2015). Character-driven stories also increase the production of oxytocin, a natural hormone produced in the brain, which motivates people to empathize, behave cooperatively, and engage in positive, prosocial action (MacDonald and MacDonald 2010). Zak (2015) describes oxytocin as “the neurologic substrate for the Golden Rule.” Thus, if you want people to understand and recall your panel, and inspire cooperative environmental stewardship, it may be useful to include a story. Figure 3 quotes a review of the importance of storytelling in interpretive panels.

**Active Learning**

*The experience is most truthful.* (Icelandic Proverb)

Storytelling is one way to enhance understanding and recall. Another effective strategy is “active learning,” a catch-all phrase for any pedagogical technique that actively engages students in the process of their own learning, as opposed to just passively listening as the instructor lectures. Examples of active learning include students solving problems or participating in a class discussion. Extensive research has been conducted on student performance in active learning versus traditional lecturing in undergraduate science, technology, engineering, and mathematics (STEM) courses. A recent meta-analysis of 225 studies found that students in classes that use active learning

strategies are 35% less likely to fail the course, when compared with students in traditional lecture classes (Freeman et al. 2014).

Panels can invoke active learning strategies by engaging the visitor in an activity. Research on active learning in education and STEM, for instance, shows that, if you make people work a little, they tend to remember the material better (Pasquale 2016; Prince 2004). If you would like to test this out for yourself, try the word-pair activity described in Table 1.

So, the question becomes: How could you design your panel to actively engage your reader? For example, some panels include questions or tasks involving the immediate environment,



**Fig. 3** The Anglesey Transport Museum: Tacla Taid (Wales). “These panels each contained a STORY! We found out where the car had come from, who had owned it previously and what kind of life it had enjoyed before it got to the museum... There were stories everywhere, and we could hardly wait to... read the next instalment.” Photo and quote by Tony Jones (2017). Image reprinted with permission from Tony Jones and The Anglesey Transport Museum

**Table 1** Active learning word-pair activity. First, take a moment to review the word pairs in (a). Then, without looking, write down all the word pairs you can remember. Now, look at (b) and count how many pairs you found in each column. On average, people remember three times as many pairs in the second column (which have missing letters) than in the first column (which contain complete words). This effect is attributed to the cognitive demand of having to mentally fill in the missing letters (Coyle 2010; Ernst 2017)

(a)	
bread/b_tter	ocean/breeze
leaf/tree	music/l_rics
sweet/sour	sh_e/sock
phone/bo_k	movie/actress
chi_s/salsa	gasoline/engine
high school/college	pen_il/paper
river/b_at	turkey/stuffing
fruit/vegetable	be_r/wine
computer/chip	television/rad_o
l_nch/dinner	chair/couch
(b)	
ocean/breeze	bread/b_tter
leaf/tree	music/l_rics
sweet/sour	sh_e/sock
movie/actress	phone/bo_k
gasoline/engine	chi_s/salsa
high school/college	pen_il/paper
turkey/stuffing	river/b_at
fruit/vegetable	be_r/wine
computer/chip	television/rad_o
chair/couch	l_nch/dinner

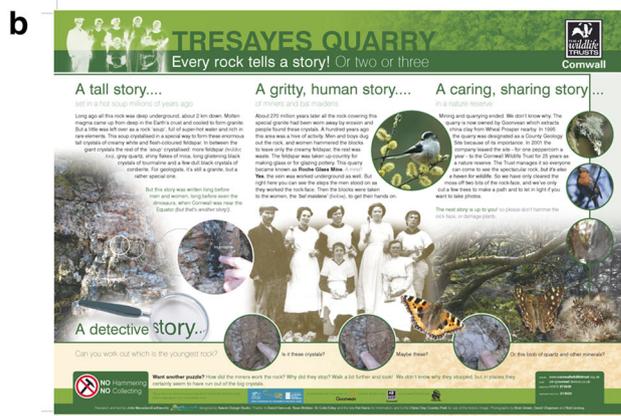
incorporate puzzles, use QR codes, or invoke additional senses, such as sound or touch (for inspirational examples, see Fig. 4).

## Making a Strong Visual Display

*Interpretation is an art, which combines many arts, whether the materials presented are scientific, historical or architectural.* (Tilden 1957)

Visual elements, such as illustrations, photographs, and maps, are the first thing people often notice. Images should reveal meaning about the heritage of the site using mood, tone, and emotion (Cross 2012; Veverka 1998). Images enhance learning and memory more effectively than words in both children and adults (Catterall and Pepler 2007; Curran and Doyle 2011), a phenomenon known in both psychology and neurology as the picture-superiority effect (Childers and Houston 1984; Curran and Doyle 2011). Visual imagery is a powerful activator of cognitive-emotional centers (Lang et al. 1998). Considering that 30% of neurons in the cortex of the human brain are involved in visual processing (Grady 1993), visual design can impact the split-second decision your audience makes regarding whether to stop and view your panel or keep walking past it.

Core elements of visual design (e.g., color, size, image placement) can communicate different things, even when using the same information, depending on composition. Differences in the organization of these core elements create what is known as hierarchical contrast, so an image that is larger or brighter may stand out as more important (Clarkson 2015) and capture your audience’s attention first. The environment in which your panel will be displayed is also relevant. For example, a green panel in a grassy area may be overlooked.



**Fig. 4** Interactive panels. **a** “Mesolithic Settlement.” This panel at Mountsandel Wood (Ireland) was designed so that visitors could take rubbings of educational illustrations. Image reprinted with permission from Tandem Design. **b** “Tresayes Quarry.” This panel at Cornwall

(UK) engages its audience by asking questions that encourage thinking and interacting with the environment, such as, “Can you work out which is the youngest rock?” Image copyright Aawen Design Studios, reprinted with permission from Cornwall Wildlife Trust

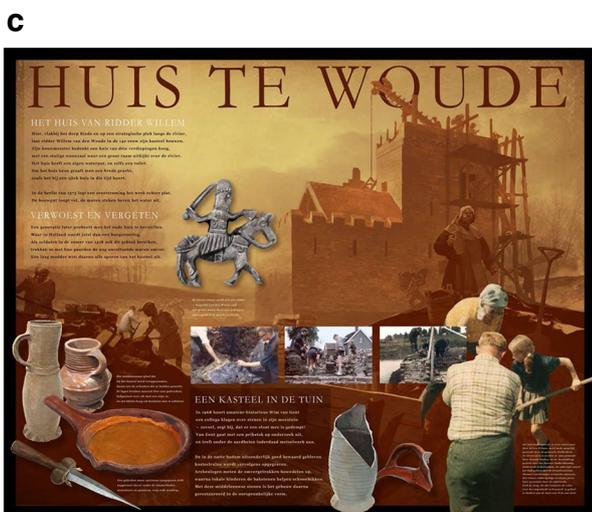
Take all of these factors into consideration when designing the visual elements of your panel. All images should have a specific purpose and integrate seamlessly with supporting text. A simple design with a clear message and singular theme is much more effective than a cluttered and confusing one (Cross 2012; Scottish Natural Heritage 2017b; Veverka 1998). Additionally, be aware that personal experience and culture can affect how an image is seen and interpreted so carefully consider appropriateness to audience while, at the same time, avoiding overgeneralizations (Lester 2013). Exemplar visual displays are shown below (Fig. 5).

Illustrations, photographs, charts, diagrams, and maps will require written permission from the copyright holder, artist, or publisher. Commissioning artwork or photographs is another

option but will accrue additional costs. Images in the public domain that have a Creative Commons (CC) license can be freely shared and used, so obtaining permission is not necessary (Harris 2018). However, be careful to research the accuracy of such claims to ensure they are legitimate and up to date.

### Inclusivity

*Diversity and inclusion are always something industries should strive for.* (Aden 2018)



**Fig. 5** Exemplar visual displays that use mood, tone, and emotion to communicate conservation and history. Note that these four panels follow the 3-30-3 rule. **a** “Boh djinoong quabba,” Lesueur National Park (Australia). Image used with permission from The Department of Biodiversity, Conservation and Attractions, Government of Western Australia, photo copyright Peter Phillipson. **b** “Talking to the Dead,” Dunstable Downs (England). Image used with permission from TellTale

(Cross 2012), photo copyright Peter Phillipson. **c** “Huis te Woude” (Woude House), ruins of a small castle in the village of Slikkerveer (Netherlands). Image used with permission and designed by Kelvin Wilson (2016). **d** “Among the Oaks,” Washington State (USA). Image used with permission from The Ridgefield National Wildlife Refuge, photo copyright J. Patrick Barry

Communicating your message in an inclusive way will help your panel connect with the full range of visitors. Be aware of pitfalls like “dead white male syndrome” in which the panel focuses excessively on white, privileged men from history (Louise 2015). Instead, develop materials that feature diverse role models, inclusive of age, gender, race, ethnicity, and persons with disabilities. At the June 2018 IXth International ProGEO Symposium, several presentations on Spain’s geoheritage projects nicely used the symbol “@” to promote gender inclusivity. For example, the word “tod@s” was used to denote everyone, instead of “todos” (male) or “todas” (female) (e.g., Vegas et al. 2018). Panels that feature images of visitors with disabilities enjoying the geoheritage site, and placed in accessible locations, clearly communicate the message: you are welcome here, you belong here.

Your choice of font can also affect accessibility. Serif fonts (e.g., Times New Roman, Georgia, Cambria) have decorative tails, which can be distracting to people with visual or learning disabilities such as dyslexia. Sans serif fonts (e.g., Arial, Calibri, Helvetica), which lack these tails, are more widely accessible (Recite Me Ltd. 2018; The National Center on Disability and Access to Education 2007). Font size can also impact readability for everyone, and particularly for visually impaired individuals. Whenever possible, panels should be located in areas that are wheelchair accessible.

## Budget

*That no matter what budget you're doing, you should be dreaming bigger than the budget you have, and then it's a matter of reigning it in to the reality.* Del Toro (Mele 2015)

When establishing a project budget, it is important to consider the full range of costs that may incur throughout the lifetime of the panel, and not just the initial panel design and production. Panel maintenance is impacted by the materials chosen and desired panel longevity, and should be budgeted accordingly (Scottish Natural Heritage 2017b). For long-term displays, the content may need to be updated periodically, incurring additional production costs. Project budgets should include accessibility needs from the outset, as retrofitting can be far more costly (Harpers Ferry Center Accessibility Committee 2017). We also recommend budgeting for professional evaluators to externally evaluate your panel, if funds permit.

## Evaluation

*The question is not what you look at, but what you see.* (Thoreau 1851)

Although hiring trained professionals to evaluate your panels is ideal, many budgets simply do not allow for this expense. Thus, you may have to choose between either not having any evaluation or conducting an internal evaluation. Faced with this choice, we highly recommend the latter.

Evaluation should be integrated throughout the panel development process: before (*front-end*); during (*formative*); and after (*summative*) production (Macadam 2018; Miles et al. 1988; Screven 1990). At each stage, various types of evaluation instruments can be used to gather qualitative and quantitative data, including surveys, interviews, focus groups (guided group discussions), and observations of visitors (e.g., how much time they engage with the panel).

In order to evaluate your panel in a meaningful way, you need to have a clear sense of your goals and metrics: that is, what you want to achieve and what counts as success. Start by reviewing your communication plan and identifying objective(s) to evaluate. SMART objectives readily lend themselves to evaluation (Doran 1981).

*Front-end evaluation* is conducted in the earliest stages of panel development to gather information from your prospective audience to inform the design process before any money has been invested in production (Miles and Clarke 1993). Front-end evaluation helps ensure your panel content is relevant and pitched at the appropriate level (Scottish Natural Heritage 2017c). Parsons (1993) summarizes and gives examples of six different question types commonly included in front-end evaluations, ranging from audience knowledge and feelings to demographics. Like all other forms of evaluation, front-end evaluation directly relates to the objective(s) you wish to accomplish.

*Formative evaluation* is done mid-way through the panel design process, after the development of a prototype. It is aimed at gathering feedback for internal use so you can make adjustments to better attain your objective(s). It may involve a preview release (“soft launch”) of the panel in the proposed location, to gauge the audience’s response before finalizing the design and location. Renard (2017) shares some useful examples of formative assessments. For example, after reading a panel, participants are asked to write three things they did not know before, two things that surprised them, and one thing they want to start doing with what they have learned.

It is vital to integrate peer review into your panel’s creation. Ask academic experts (e.g., geologists and communication specialists) as well as individuals representative of your audience to review draft images and text and provide critical feedback. Such feedback will help ensure the information you are communicating is scientifically accurate, historically and culturally appropriate, and engaging (Macadam 2018).

*Summative evaluation* is conducted “after the fact.” Rather than informing panel design, summative evaluation metrics measure how effective a panel was in the location where it was exhibited. They are designed to measure whether the

panel met the stated objectives and can cover topics such as impact on visitors, impact on policy, and cost-effectiveness (e.g., do the results justify the panel's cost?). Summative evaluation results can be useful in informing the design of future panels, or included in grant applications to demonstrate past successes, but they arrive too late to inform the particular panel being evaluated.

**Dissemination** Sharing your results with your peers in the geoheritage community is a critically important but often overlooked final step in the evaluation process. Communication strategies that may work well in, say, a formal education environment may not work well at a geoheritage site, where visitors may have primary motivations other than learning (Hose 2006). In order to develop a body of knowledge specific to geoheritage communication panels, disseminating evaluation results, whether favorable or unfavorable, is essential.

**An Important Note** Understanding your audience impacts both the inputs and the outputs of the evaluation process. Different audiences may react very differently to the same panel. For example, consider the metric of place attachment, with high person-place bonding being an expected result from successful panels (Tan et al. 2018). In a recent large study examining place attachment at the Osun Oshogbo Cultural Festival (Nigeria), statistically significant differences ( $p < 0.001$ ) were found between tourists ( $n = 461$ ) and residents ( $n = 469$ ) in their degree of place attachment (Woosnam et al. 2018). In another study, visitors were classified into four types, depending on their use of interpretation. Stewart et al. (1998) showed that efficacy in extending the understanding of the park as a special place depended on visitor type. These studies underscore the importance of defining your target audience in the earliest stages of evaluation design, and avoiding overly generalizing results to different audiences.

## Conclusions

*I've learned that people will forget what you said, people will forget what you did, but people will never forget how you made them feel.* (Angelou 2004)

Effective panels are engaging, communicate emotion, and inspire action. To create an effective panel, first, develop a communication plan to crystallize your purpose, message, and audience. At the project's outset, choose the panel location and set a realistic budget. Next, design the panel with concise text using the 3-30-3 (or 3-30-1) guideline, so visitors

can learn your take-home message in 3 s, absorb supporting information in 30 s, and read and understand the entire panel in 3 (or 1) minutes. Storytelling and active learning are proven techniques to increase understanding and recall. Use strong visual images to convey emotion and mood, paying attention to core elements of visual design and how they may convey hierarchical importance. To connect with the full range of your target audience, strive to be inclusive, for example, by using accessible font and diverse role models. Integrate evaluation throughout the panel development process using front-end, formative, and summative methods. Finally, disseminate your results to your peers in the geoheritage community to contribute to the body of knowledge regarding design and evaluation of interpretive panels.

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