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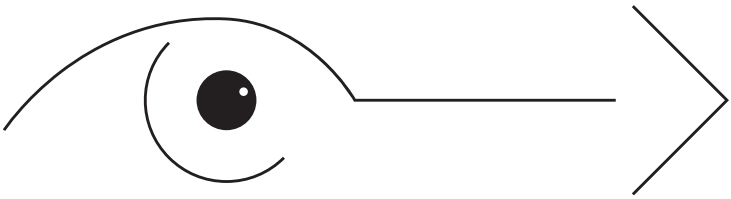

Before there was reading there was seeing. *Visible Language* has been concerned with ideas that help define the unique role and properties of visual communication. A basic premise of the journal has been that created visual form is an autonomous system of expression that must be defined and explored on its own terms. Today more than ever people navigate the world and probe life's meaning through visual language. This journal is devoted to enhancing people's experience through the advancement of research and practice of visual communication.

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Guest Editor:
Maria dos Santos Lonsdale

December 2018

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Contents

Editor's note:

All the articles for the Student Special Issue went through our standard double-blind peer-review process. The only concession to our normal research publication standards was occasional allowance for fewer research participants than might otherwise be necessary.

We hope to repeat this student special issue at various times in the future as a way to support our mission of advancing communication design research and scholarship.

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Student Special Issue

Visible Language is happy to present a Student Special Issue that includes articles on student research into Typographic and Graphic design involving user-centered research methods. The importance of focusing on user-centered approaches emerges from a need identified through years of experience as a lecturer, researcher and design practitioner. Design solutions that are driven merely by opinion and intuition, without having involved the target user throughout the different stages of the design process, nor having been tested and developed through several stages of iteration and re-design, might be prone to failure. Design that is developed for the user and with the user stands a greater chance of high and long-term impact.

The objective of the Student Special Issue was to support early career scholars by giving them an opportunity to experience the publication process, and to encourage supervisors/tutors to be involved in the publication process with joint authorship where appropriate.

In this Student Special Issue we have included a wide range of research themes that show the potential of the field of Typographic and Graphic Design to produce novel user-centered design and research solutions that are directly applicable to real life contexts. These include research on: the interrelation between handwriting and personal branding; children's engagement with health and safety posters; the effectiveness of two-dimensional versus three-dimensional museum guide maps; the appropriateness of different styles of illustration for visual resources used in combination with assistive technologies for people with aphasia; the effects of reading from paper versus an eInk display on recall and reading speed; the potential of garment label design and companion information to communicate fashion sustainability issues to young consumers; the application of digital drawing within remote Indigenous contexts; the documenting of live art by locating and empowering the document user.

The publication of this Student Special Issue would not have been possible without the support of Mary Dyson (Department of Typography & Graphic Communication at the University of Reading, UK), the hard work of a strong body of reviewers from various parts of the world, and the patience and skill of Mike Zender, editor of *Visible Language*, in making sure the layout and images were a good representation of the research and design outputs.

Maria dos Santos Lonsdale, *Guest Editor*

Two-dimensional vs three-dimensional guide maps: *which work best for museum visitors?*

Andrew McIlwraith

This study aims to investigate the relative effectiveness and appeal of two designs of printed map designed for visitors to a museum. The two maps investigated differ in the projection of the building depicted: one is a series of two-dimensional floorplans, the other is a three-dimensional (axonometric) diagram of the museum. The study included a task in which participants were asked to plot a route on the map and then find their way to a predetermined destination in the museum, using one or other of the maps. Their ability to find their way successfully was assessed, and they were asked to describe any problems they encountered following the route. The second part of the study investigated participants' opinions of the map as an aid for planning or undertaking a visit to the museum. Finally, they were shown the alternative map to the one they had tested and asked to say which one they preferred and why. The results show that there are no marked differences in the effectiveness of the two types of map to facilitate wayfinding. Opinions were divided about which type of map was most useful, though almost all participants stated a preference for one or the other. The three-dimensional map was widely considered to provide a better overview of the building as a whole, and how different floor levels were connected. However, the three-dimensional map was also perceived as more complicated by some participants, which, for a minority, made it less preferable.

Museums can be confusing destinations for visitors, who arrive with a range of expectations, understanding of the museum's content, knowledge of its exhibits and cultural backgrounds.[1] Many visitors are first-time or infrequent visitors and therefore have little or no understanding of the physical extent and arrangement of the museum building(s) and spaces. Being unable to fully understand what is in a museum may mean that visitors do not make the most of their visit; and being disoriented in a building can lead to feelings of frustration and stress (Carpman and Grant, 2002). It is not surprising, therefore, that visitors have an "insatiable" appetite for orientation information (Cohen et al, 1977).

Museums provide a range of resources to help visitors plan what to see and how to find it, including, variously, guidebooks, wall-mounted 'you-are-here' maps and directories, paper maps, signs, museum staff and volunteers, audio- and multimedia guides, and smartphone apps. Paper maps are provided by virtually all large museums around the world (and many smaller ones) to visitors (Falk and Dierking, 2013), either for free, at low cost, or as part of an entry ticket price. They are an important part of a museum's navigational resources (Bitgood, 2011), and are widely used by visitors, compared with other resources (Hayward and Brydon-Miller, 1984).[2]

Research into the effectiveness of museum map design is limited. There is a large body of research into wayfinding within buildings generally, including into the effect of building layout on wayfinding ability (Weiseman, 1981), the relative usefulness of wayfinding resources (such as signs and maps) (Hölscher et al, 2007), and on wayfinding problems in particular buildings (Beaumont et al, 1984). More specifically, Cheng and Pérez-Kris's (2014) study of wayfinding in a complex medical environment found that paper maps were effective at facilitating wayfinding, though there were some problems. However, wayfinding is only part of the role of museum maps, and probably the less important role. Conceptual orientation – providing visitors with information about what the museum contains and how it is arranged – is a more important role for maps (while signs, for example, better assist wayfinding) (Cohen et al, 1977).

Some museums and wayfinding designers have tested visitors' responses to prototype map designs (for example, McManus, 2003), which includes maps' ability to aid conceptual orientation, but this research is mostly for museums' internal use only. It is often limited in scale and scope and, therefore, provides limited insights for museum map design more generally.

Since most museum maps convey large amounts of layered information (including, variously, the arrangement of spaces within building(s), the way the displays are organised and categorised, recommended routes through the museum, the location of facilities such as toilets and restaurants, and the location of the museum's highlighted objects), there are many aspects of museum map design that could be investigated. However, a fundamental one that is at the core of how well the map can be understood is the way the museum building is depicted. Many museum maps use three-dimensional projections (axonometric or perspective) instead of two-dimensional floor plans, but the rationale for using one over the other is unknown.

The limited amount of study in this area has provided scant evidence of the relative effectiveness of two-dimensional and three-dimensional projections at aiding understanding of a building's layout, or facilitating wayfinding. Laakso's (2002) study comparing a digital three-dimensional map of an urban area with a two-dimensional paper map found that the two-dimensional map was more effective for navigation, though users found the three-dimensional map more "fun" to use. And the main conclusion of Morris and Alt's (1978) study comparing a floor plan and an axonometric map of part of a museum, was that the axonometric map was a "more attractive form of presentation" because it appealed more to young visitors.

Purpose and design of research

This study aims to provide insight into the relative qualities of two-dimensional and three-dimensional projections of museum maps, in particular, to investigate users' ability to interpret each type to navigate a museum and whether they prefer one type over the other.

Ability to facilitating wayfinding can be assessed through recording how effectively and efficiently undertake a wayfinding task (ie, travelling from one point to another). Conceptual orientation is less straightforward to assess because it is about how well a map can convey information about the extent and layout of the museum building and its displays. And not all visitors will want the same information from a map: conceptual orientation requirements are dependent on individual visitors' expectations, experience and manner of visiting a museum. Therefore, this aspect was assessed according to individuals' opinions of a map, and their views on what they considered useful and not useful aspects of its design.

The study comprised three parts, each involving the use of test materials that comprised a two-dimensional and a three-dimensional map of a particular museum:

— 1. 20 participants undertook a wayfinding task in which they used one of the maps (10 for each map) to plan a route and then find their way to a predetermined destination within the museum.

— 2. The participants then rated how useful they believed the map would be more generally for planning

1 More than half of visits to DCMS-sponsored museums in 2015-16 were from overseas (DCMS, 2017)

2 Also confirmed by studies by McIlwraith for an unpublished doctoral thesis, which includes the research in this article

or undertaking a visit to the museum, and were asked for their reasons for their rating, and about aspects of the map they found particularly useful or not useful.

3. Participants were then shown the alternative map to the one they had used and assessed, and asked to say whether they thought the alternative map would be better than the original one for planning or undertaking a visit to the museum, and to give their reasons.

Test location and materials

The museum chosen as the location for testing was the National Maritime Museum, Greenwich, London, a relatively large building, with a complex environment (partly a historic building, with the addition of a modern wing); it has a varied collection that includes interactive displays and static artefacts of varying sizes and types; and has a non-sequential layout (ie, there is no recommended or pre-determined route through the museum); and it is designed to appeal to multiple audiences (including special galleries for children of different ages).

The museum publishes a map for its visitors within a leaflet (*Figure 1*) that was considered suitable as a basis for the test materials. The map is also available as an A4-sized pdf download from the museum's website. As well as the printed museum map, the other wayfinding and orientation resources in the museum are: wall-mounted "you-are-here" maps (*Figure 2*); wall-mounted directories (*Figure 3*); two information desks; and staff and volunteers throughout the museum who provide advice and directions.

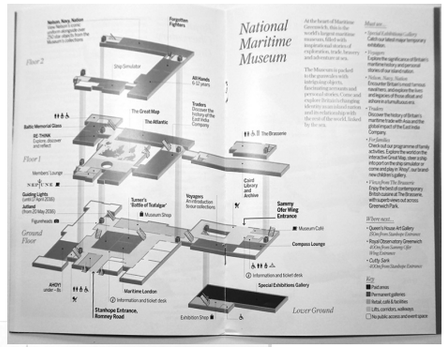
Producing test materials

The existing National Maritime Museum map was considered to have an appropriate design and level of detail to be used as a basis for testing. The map has the following key characteristics:

- It depicts four floor levels, each a different shape and size, in an axonometric projection.
- The levels are depicted as "2.5D", ie, each floor is rendered independently, rather than as a complete 3D rendering of the entire building, with vertical architectural elements such as walls, windows and doors. However, the floors are aligned vertically as they are in the building.
- A five-colour colour-coding system is used to denote different types of space function: paid areas; permanent galleries; retail, café and facilities; lifts, corridors, walkways; and no public access and event space.
- Text labels are used to locate particular galleries, displays, facilities and entrances. Some of the galleries labels also include some descriptive text (see, for example, *Figure 4*).
- Pictograms are used to denote the location of facilities,

FIGURE 1

leaflet



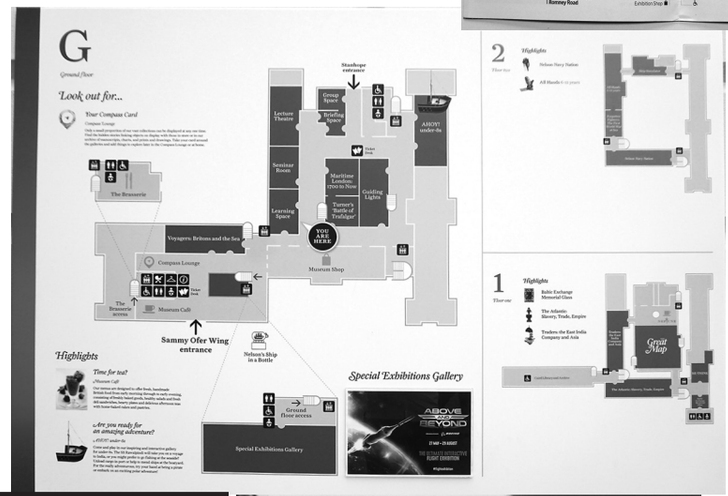


FIGURE 2

"you-are-here" map

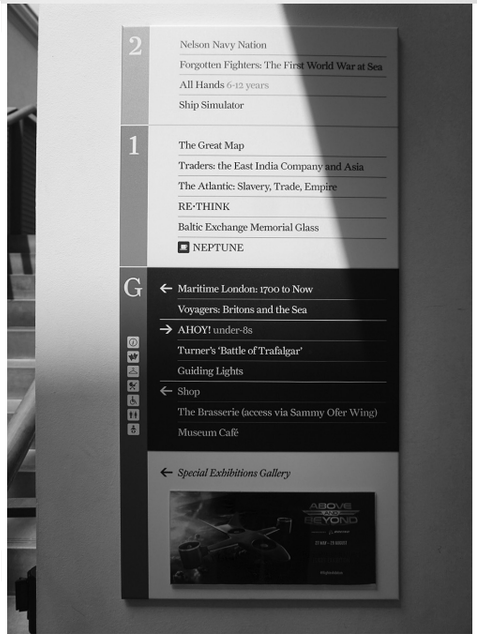
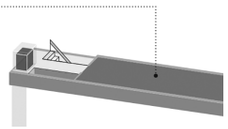


FIGURE 3

wall-mounted directory

FIGURE 4



including: toilets, restaurant, café, shop, baby-change area, information, pram/pushchair storage and cloakroom. No key is provided to these pictograms, though a small number are accompanied by an explanatory text label.

The museum's existing map was used as the basis for the design of a two-dimensional map. Since the purpose of the exercise was to make relative judgements about two-dimensional and three-dimensional maps, it was considered important to retain as much graphic equivalency as possible, in relation to the amount and style of information and level of detail. This exercise in itself was also instructive in isolating those elements that contribute to the differences between two-dimensional and three-dimensional building plan projections more generally. The two maps used for testing can be seen in *Figures 5* and *6*. The process of developing the test maps is discussed below.

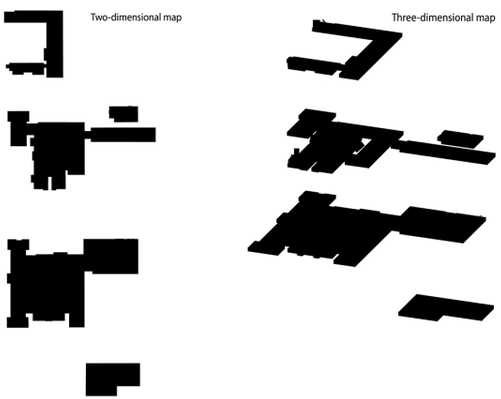
Shape, size and orientation of map

It was considered important that the perceived size and scale of the maps be as similar as possible, in order to remove the possibility that either map could be easier to read than the due to being, or appearing, larger. Since an axonometric projection is not a scaled projection, it was considered the most effective way to do this was to ensure equivalent perceived size. This was done by scaling each map relatively to ensure the surface area of each (the "ink area") was similar (see *Figure 7*).

Showing vertical circulation: lifts

The museum contains five lifts, only three of which connect the main three floors (Ground, Floor 1 and Floor 2). This arrangement, where all the lifts do

FIGURE 7



not connect all the floors, is not unusual in complicated buildings, but it nevertheless creates problems for visitors, who, in the absence of visual cues, are not able to understand the limited destinations of lifts.

In the museum's existing three-dimensional map, lifts are denoted with a simple three-dimensional box-shaped symbol, and partially transparent coloured bands indicate the journey each lift makes (and therefore the floors that they visit) – see *Figure 6*. It is not possible to use this system with the two-dimensional map, because each floor is a discrete graphic element. The box device was replaced by a pictogram for a lift in each case. Further, the two lifts that connect only two floors are labelled with text explaining this, in order to help map users avoid attempting to use those lifts to travel to other floors.

Showing vertical circulation: stairs

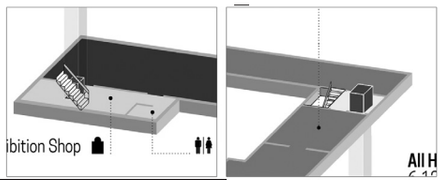


FIGURE 8

The three-dimensional map uses a three-dimensional rendering of each set of stairs to indicate the location, orientation and direction of travel of staircases. This is a more sophisticated visual representation of stairs than the stair symbol on the two-dimensional map, which provides more information (the direction of travel), but it can be problematic at some points, where the symbol is partially concealed by other parts of the map (see *Figure 8*).

Also, despite its detailed rendering, the three-dimensional stairs symbol does not always accurately represent the size, shape or orientation of each stairway. In one case, the orientation of the stairway is not correct, which is likely because of the difficulty in rendering the stairway in the correct orientation at that particular point – this is discussed further in "Research findings: wayfinding".

Another problem is that it does not render staircases that run through more than two levels. The part of the museum depicted in *Figure 9*, for example, has a staircase that links all four levels, though the way this is represented (as four unconnected sets of stairs) means that this may not be clear to the museum visitor.

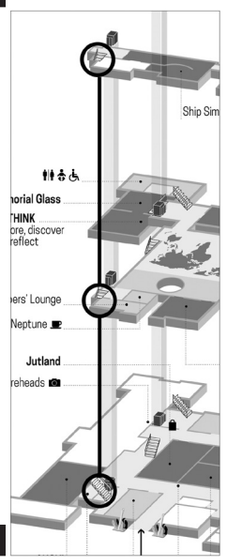
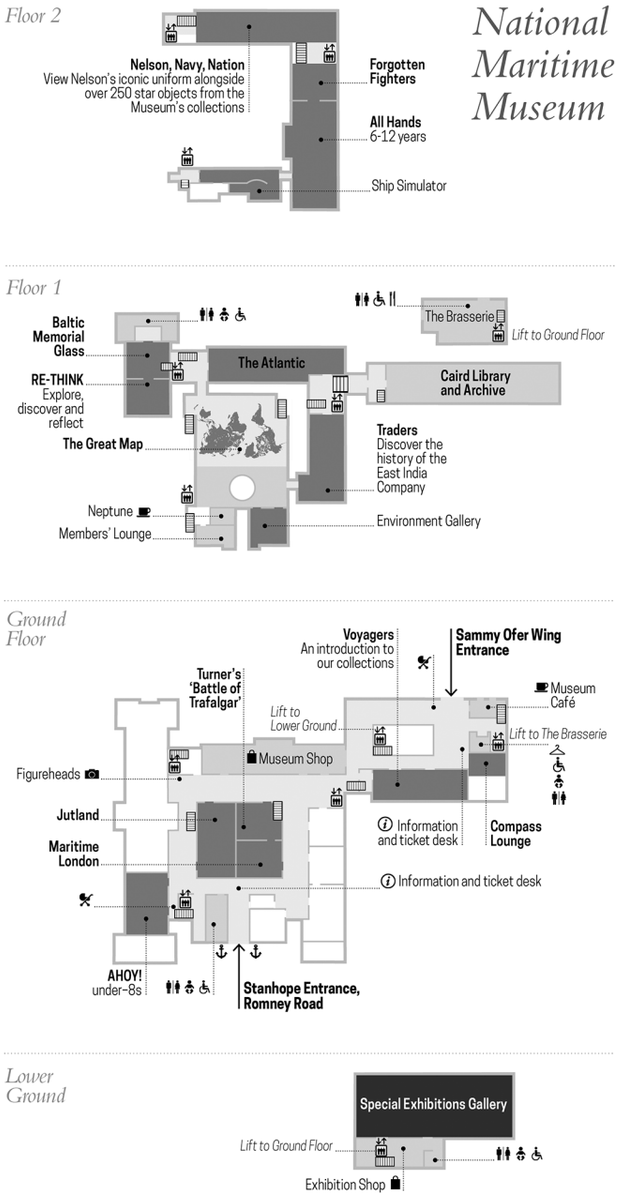


FIGURE 9

FIGURE 5



National Maritime Museum

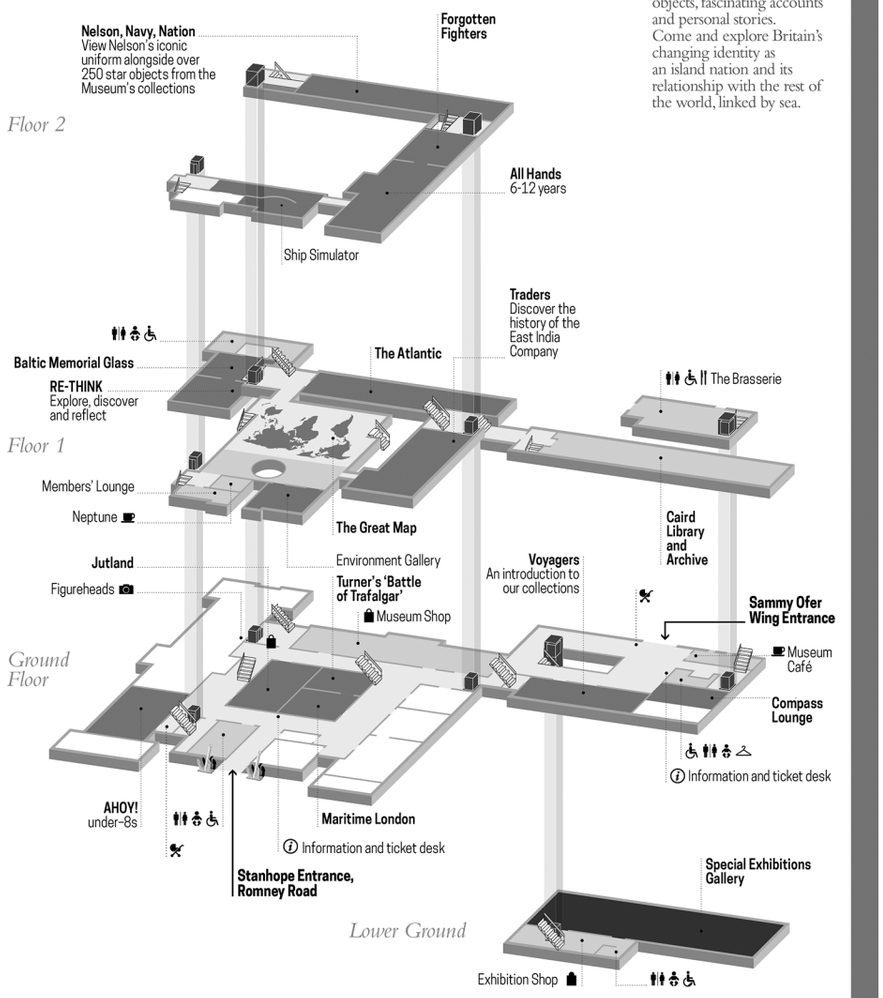
At the heart of Maritime Greenwich, this is the world's largest maritime museum, filled with inspirational stories of exploration, trade, bravery and adventure at sea.

The Museum is packed to the gunwales with intriguing objects, fascinating accounts and personal stories. Come and explore Britain's changing identity as an island nation and its relationship with the rest of the world, linked by sea.

Key

- Paid areas
- Permanent galleries
- Retail, café & facilities
- Lifts, corridors, walkways
- No public access and event space

FIGURE 6



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Research participants

Participants were adults who had volunteered to attend the museum for approximately an hour to take part in the research project outlined in the Information Sheet. Potential participants were excluded from the research if they worked for a museum, or as a curator, museum or exhibition designer or professional guide; or were professionally involved in graphic design, information design, or map-making.

Limitations of this aspect of the research include:

- No attempt was made to include or take account of people with disabilities or special needs, be they mobility-related or perceptual (such as colour-blindness or dyslexia).
- Participants were all resident in the UK and were native English speakers, so there was no allowance for cultural or language differences, for example, from tourists, who are a major museum-visiting group.
- The study tasks were undertaken by participants individually, which may not be their typical manner of visiting a museum (that is, that they are more likely to visit with family members or companions), which may affect their visiting, map use and wayfinding behaviour.

Research procedure

Appointments were made to meet each participant at the museum's Sammy Ofer Wing entrances. They were asked not to visit the museum before the meeting. After confirming that they had read and understood what would be required of them from the Information Sheet, the research process was begun.

- 1. The participant was asked a series of preliminary questions about their museum-visiting habits and behaviour, and, in particular, their use of museum maps. The participant was then shown either the two-dimensional or three-dimensional map, and told that it was a map of the museum they were in, and where on the map they currently were. They were asked to locate and mark on the map a particular gallery that was labelled: half the participants were asked to locate on the map one of two destinations: the Forgotten Fighters gallery or the Baltic Memorial Glass gallery. They were then given a pencil and asked to trace the route they would take from their current location to this destination.
- 2. Having drawn their chosen route on the map, they were told that they should make their way to the gallery. They were told that this task would also be timed, but that they should make the journey at a normal pace. They were told that they did not need to follow the route they had plotted if they could not, or thought there was a better way. They may also make use of any signs in the museum that they came across, but they should not seek or accept any offered help from gallery staff. The participant was instructed to announce their arrival at the destination by immediately calling the researcher's mobile phone.
- 3. Having notified their arrival, the participant was then questioned about their experience of finding their way to the destination, in particular about how well the route they had planned had worked, whether they had followed it and, if not, why. They were then asked to rate how useful, in general, they felt the map would be for a visit to the museum, their reasons for this, and any features or aspects of the map they felt were particularly useful or not useful.
- 4. Finally, the participant was shown either the alternative map to the one they had used, that is, the two-dimensional map if they had used the three-dimensional one and vice versa. They were asked whether they thought it would be better or worse for planning a visit to or visiting the museum, their reasons for this, and for any particular features or aspects of this map that they thought were more useful or less useful than the first map they had used.

Research findings: wayfinding

The participants' first task was to plot a route on the map to one of the two test destinations (the Forgotten Fighters gallery or the Baltic Memorial Glass gallery). Overall, three-quarters of the participants (15) were able to plot a feasible route to the given destinations. Four participants plotted routes that were not feasible (ie, they would not work, for example, because their route moved from one floor level to another at a point where there were no means of doing so) - two each for the two-dimensional and three-dimensional maps. One person stated that he could not plot a route because he could not work out where the stairs were on the map (the two-dimensional map).

Following a route

All of the participants managed to reach the destination in the museum they had been asked to find, in a reasonable time (that is, under 10 minutes) – including the participant who was unable to plot a route on the map. There were only minor differences in times between users of the two types of map, and these cannot be considered significant, due to the study sample sizes.

However, the speed of reaching a destination in a museum is rarely a matter of importance, unlike in certain other built environments, such as airports or hospitals, where the consequences can be critical (de-

layed urgent treatment or missing a flight). Several participants pointed out that they considered the task theoretical or artificial, since when visiting a museum, they would rarely be completely focused on reaching a particular destination and would often stop to look at something on the way that caught their attention.

Although all participants found their way to their destination, and within an acceptable time, most – 13 out of the 19 participants who plotted a route – did not follow the route they had plotted on the map exactly. The number of participants who did not follow their route was slightly higher for those using the three-dimensional map than for those using the two-dimensional map, but the difference cannot be considered significant.

Diverting from a plotted route may not be significant in practical terms, for example, if it does not cause undue delay. However, feeling lost can evoke feelings of confusion, frustration or anxiety (Carpman and Grant, 2002). These kinds of feelings can potentially reduce a visitor's enjoyment of the space they are visiting (Passini, 1966). Alternatively, or in addition, it may cause them to lose confidence in the map or in their map-reading skills, which means that the usefulness of the map as a tool for aiding the visiting experience is compromised.

Of those participants who did not follow the route they had plotted, seven can be considered to have had serious problems following their route (including testers of both types of map). This is because they made lengthy deviations from their plotted route or expressed concern about feeling lost, confused or disoriented, and having to take corrective action to find a route to the destination. For example, one participant who tested the three-dimensional map said:

— *I couldn't orientate myself to begin with, I was confused. I couldn't find the "Traders" gallery on the map. When I started in the wrong direction, I thought any stairs would do, and then realised, when I reached the bistro [Brasserie], that they didn't.*

Another participant, who also tested the three-dimensional map, said:

— *I found a lift past the toilets and took it, but it went only to the first floor, so I came back down and walked back through the shop and saw another lift and took that one, which went to the second floor. I thought I knew what I was doing but I didn't.*

Two of the five participants who used the three-dimensional map to travel to the Baltic Memorial Glass gallery encountered the problem of the incorrectly oriented set of stairs, mentioned earlier (see "Showing vertical circulation: stairs"). Both these participants made relatively lengthy deviations from their plotted routes as a direct result of the fact that these wrongly depicted stairs led them to believe they were facing a direction that was at 90 degrees to their actual orientation. Both said they felt confused during the task, but neither had identified that there was an error on the map until it was pointed out to them in the debriefing session.

Feelings of confusion or disorientation were expressed even by some participants who either made only minor diversions from their plotted route or followed it exactly. This was generally due to parts of the actual museum seemingly not matching their expectations of them from what they were seeing on the map. For example, one participant said:

— *I followed the route exactly, but I didn't know it would look like that -- I didn't realise the lift would be where it was.*

This kind of mismatch may invoke anything from brief feelings of confusion to a more enduring sense of insecurity. For example, one participant said:

— *I followed down the [stairs] next to the Forgotten Fighters gallery and it goes around the edge, not the way it is shown [on the map]. You can't match the illustration with what you're seeing – it makes you feel insecure.*

Research findings: conceptual orientation

Generally, most participants had a positive view of the maps: 14 of the 20 said the map they tested would be "very" or "fairly" useful for visiting the museum. *Table 1* shows the range of ratings for the two types of map. Overall, the two-dimensional map was considered more useful than the three-dimensional map. Analysis of the ratings reveals that only one participant who tested the two-dimensional map gave it a negative rating, while the higher number of negative ratings by testers of the three-dimensional map to a large degree effectively offset the positive ratings. So a more accurate conclusion is that opinions are more divided over the three-dimensional map than the two-dimensional one.

TABLE 1

Participants' ratings of tested maps

Rating	Number of participants	
	3D map	2D map
Very useful	2	2
Fairly useful	3	7
Not very useful	4	1
Not at all useful	1	0

TABLE 2

Participants' ratings of alternative map to map tested

Rating of alternative map	Number of participants	
	3D map testers	2D map testers
Much better	2	5
Slightly better	4	2
Neither better nor worse	0	1
Slightly worse	4	1
Much worse	0	1

Comparative ratings of the two types of map

When asked to whether they thought the alternative map would be better or worse than the one they had tested, overall, participants who had tested the two-dimensional map rated the three-dimensional map more highly than vice versa – see *Table 2*. This would appear to be at odds with the

usefulness ratings of the tested maps, as described above, where the two-dimensional map was scored as more useful overall. However, there are several possible contributory explanations for this apparent discrepancy. First, the sample sizes in this study in both cases, there was a spread of ratings from positive to negative, indicating that preferences vary from individual to individual. Second, the assessments were not symmetrical and directly comparable, since, of course, the alternative map was being rated only in comparison to a different map that they had used to undertake a wayfinding exercise, without prior knowledge of the map, or the route.

There are two particular possible consequences of this, in relation to the ratings given:

— The three-dimensional projection of the building might be considered to have a more "sophisticated" design, and this may be considered more novel or appealing to those participants who had tested the two-dimensional map; conversely the two-dimensional map may be seen as "simplistic" or more basic than the three-dimensional map, to those participants who had tested the latter.

— Having already (successfully) used a map that had many similarities to navigate the museum, and having also familiarised themselves with the museum, those participants who tested the two-dimensional map may have felt more confident and positive about the more sophisticated and (possibly) more complex three-dimensional map than they otherwise would have.

These are just two possibilities about how participants may have reached their judgments. But, as Nisbett and Wilson (1977) have reported, there is much evidence to suggest that people are often unaware of how stimuli in controlled situations affect responses. In relation to this experiment, this means that participants were not necessarily making the rational judgments they might be presumed to be making; ie, on whether the alternative map they are looking at would, in reality, be better or worse for them when visiting a museum in terms of such measures as ease of understanding the layout of the building and how to navigate it, and the displays in the building and how they are arranged. It is therefore not possible to demonstrate how far (if at all) the speculative processes described above affected their overall ratings of them. However, it is clear that there are several possible reasons related to the test method and structure that suggest that the overall relative scores are not necessarily contradictory.

Liked and disliked features of the maps

Having provided overall ratings, participants were asked to explain any features of either map that they would find particularly useful or not useful. Most participants named both positive and negative features of the maps, covering a wide range of themes and points. Those that relate specifically to two-dimensional and three-dimensional projection are discussed below.

Depiction of stairs and lifts

Vertical circulation in a multi-level building can be a major source of wayfinding problems. For example, Hölscher et al (2006) found that staircases were the single most clearly identified cause of wayfinding problems for visitors in a complex, multi-level building. In the maritime museum study, half of the 20 participants made comments indicating that they had difficulty understanding how the stairs and/or the lifts connected the floor levels. One participant, using the three-dimensional map, was even under the impression that there were no stairs in the building.

With the two-dimensional map, some participants said they did not always understand where the stairs led to (to a floor above, one below, or to a different level on the same floor), because there is no information on the map (arrows or text, for example) indicating this.

The more sophisticated stair device used on the three-dimensional map had different problems. Because of the way it was rendered, it could be misinterpreted as an accurate illustration of each set of stairs, rather than a symbolic representation of them, which confused some participants. Comments included:

— *The stairs are at different angles; it doesn't make sense to me.*

— *I find the connections between the floors and how the floors fit together confusing. I wasn't sure why the same stairs were represented twice on different levels to fit them together.*

— *What are the stair symbols? They end mid-air*

The depiction of the lifts provoked fewer negative comments from participants than the depiction of stairs. Two testers of the two-dimensional map said that they were initially unsure where the lifts were because the key did not explain the lift symbol that was used. And three participants said they did not initially understand the symbols denoting the lifts on the three-dimensional map.

However, some participants made favourable comments about the way the lifts and their path of travel were shown on the three-dimensional map.

Orientation of map

When producing a map or diagram of a building, there are important considerations related to how the map is oriented. A two-dimensional map provides an overhead view of the building so, on its own, it can be read from any angle, regardless of the orientation of the page on which it is printed. However, there are two aspects of the design that determine how the orientation at which the map can be read:

— the arrangement of the plan of different floors or levels in a

multi-level building; by convention, the plans for each level are arranged with the uppermost floor at the top of the page and the lowermost at the bottom, as a metaphor for the actual arrangement of the floors in the building, and

— the orientation of labels, text, symbols and images that are on or relate to the plan, which are typically in only one orientation.

One widely accepted convention of orientation maps is that they should be "head up", that is, with an assumed starting point at the bottom of the map, and direction of travel from the bottom to the top of the map (Andrews, 2002-03). In the case of a building, this generally means the entrance. However, Wright et al (1990) found that designing a map so that the building entrance is at the bottom of the map may not be the best to facilitate user orientation, and that it can be better to orient the map according to a space or area (such as a main corridor) from which most of a building user's (navigational) "problem solving" will be done. However, many buildings (including the National Maritime Museum) do not have a single area or point from which such "problem solving" will be done. The museum has two entrances, on opposite sides of the building, and there is no single "starting point" or defined pathway through the museum.

A three-dimensional map is more complicated since it is constructed from a single viewpoint. In the case of the National Maritime Museum, this is the building's eastern corner. Having two entrances on opposite sides of the building creates particular problems for the three-dimensional map. The viewpoint for the museum's three-dimensional map means that the orientation is correct only for visitors who enter by the Stanhope Road Entrance. The other entrance, the Sammy Ofer Wing Entrance is in a "head down" direction, which can make orientation difficult, as one participant noted:

— *If you come in the park [Sammy Ofer Wing] entrance, everything is upside-down – I find that confusing.*

In order to counter this problem, some map users physically rotate the document, even if this has the effect of rendering text and other elements less readable. But this much more problematic with a three-dimensional map – as *Figures 10* and *11* show, it is much more difficult to read a rotated three-dimensional map than a rotated two-dimensional one.

Perceptions of complexity

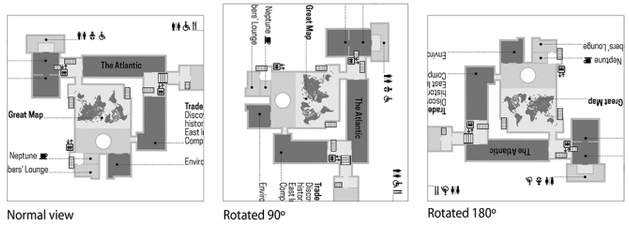
Many participants made comments relating to perceived complexity or complication in the maps. Comments about the two-dimensional map included:

— *It's pretty muddy to me. I think it has all the information I need. But I think you would need to study it for five minutes to begin with, I don't think it's very clear at all.*

— *It's a bit 'bitty'. There are lots of little bits of information and it looks a bit incoherent.*

FIGURE 10

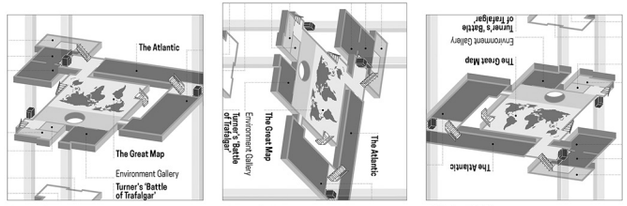
Effect of rotating the two-dimensional map



Normal view | Rotated 90º | Rotated 180º

FIGURE 11

Effect of rotating the three-dimensional map



Normal view | Rotated 90º | Rotated 180º

— *I think there is too much in it. The two-dimensional map looks a bit cramped, but maybe that's just an optical illusion.*

Comments about the three-dimensional map included:

— *It's quite busy – it's a random series of headings, and why would you choose one over the other?*

— *The three-dimensional map has added complications that are confusing. Also, the labels on the three-dimensional one are more complicated.*

— *It looks too much like an engineering diagram to me… it just looks so busy.*

Overall, there was no clear consensus that one type of map was considered as more complicated than another. In describing the differences between the two maps, some participants characterised this in terms of being able to take in the whole museum in one view with the three-dimensional map, while the two-dimensional one could only be considered one level at a time. However, there were divergent views about whether one type was better than another – reflecting the ratings given by participants, as shown *Table 2*.

— *I could work with the 2D one, but it's easier to grasp the overall layout of the place with the 3D one.*

— *I do understand better how the museum fits together with the 3D map. This is closer to your experience [of moving through the museum] in some ways… it gives you a better idea of the space.*

— *I feel like you can interact more with the 3D one and imagine yourself walking through the different floors.*

— *In my head, I can compartmentalise the bottom floor, top floor, but [the 3D] map tries to make me think in three dimensions.*

— *It's straightforward and head on. I can work it out straight away. The 3D one has added complications that are confusing.*

Conclusion

Based on the experiences of 20 people who took part in a controlled assessment of two-dimensional and three-dimensional maps of the National Maritime Museum, it cannot be said that one type or the other is superior as a wayfinding and orientation device for museum visitors.

Both types of map proved useful and largely effective wayfinding devices. Most of the participants in the research were able to plot a route to a destination within the museum without significant difficulty. And all managed to reach the destination when seeking it out, though in a few cases participants had some difficulties, and had to rely on other wayfinding devices (signage and landmarks primarily) to complete their journeys. Some participants noted feelings of confusion and disorientation, which can have a negative impact on the museum visiting experience.

As conceptual orientation tools, both maps can be considered successful, since most research participants rated the maps as "very" or "fairly" useful for a visit to the museum. The design of the study does not allow for conclusions about which type may be best. Anecdotally, though, there are mixed findings: overall, testers of the two-dimensional map gave higher ratings than testers of the three-dimensional map, but, when participants were shown the alternative to the map they tested, the three-dimensional map overall was rated better than the two-dimensional one. There are complex possible reasons for this, relating to the research design and to limitations in cognition awareness. For some participants, it may be a case of finding the more sophisticated projection of the three-dimensional map more attractive, or at least more intriguing.

All but one of the participants expressed a preference for one type of map over the other. Participants' comments suggest that many considered the three-dimensional map to be more complicated, though, the ability to take in the building as a whole, and to understand how the lifts connect the floors, was noted by many as an advantage. However, the strongest negative comments were about the three-dimensional map, with two participants stating they disliked the map so much they would not use it if it were given to them.

Limitations

In relation to the wayfinding task in this study, as with any experiment of this type, there are limitations around the behaviour of participants in an exercise they know is being timed and reported on in relation to how they used the map, compared with how they would use a map on an actual visit to a museum.

More important limitations relate to the test location and the test materials. Although both maps were standardised as much as possible such that the focus of difference between the two was their projection (that is, two-dimensional versus three-dimensional), it is not possible to know how other aspects of the design (for example, symbols, labelling and colour-coding) influenced either the wayfinding results or the participants' assessments of the maps.

All museums, including the National Maritime Museum, have unique attributes, not least their physical spaces. Invaluable further insight into the relative positive and negative aspects of two- and three-dimensional maps would be gained by repeating this study in other museums, probably of different sizes and different focuses (for example, an art museum).

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