# Remote Evaluation of WCAG 2.0 Techniques by Web Users with Visual Disabilities

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**Abstract.** The Web Content Accessibility Guidelines represent an opportunity to provide concrete, structured guidance for designers and developers regarding how to build accessible web pages. However, there is currently a lack of evidence regarding which techniques contained within WCAG 2.0 produce accessible websites. This paper presents a methodology for evaluating implementation techniques with remote users and demonstrates its use in evaluation techniques for one Success Criterion of WCAG 2.0.

**Keywords:** web accessibility, Web Content Accessibility Guidelines, visually disabled web users.

## 1 Introduction

The Web Content Accessibility Guidelines (WCAG) [3, 4] from the World Wide Web Consortium (W3C) are the main source of information on the development of web content that is accessible to people with disabilities. WCAG has been used by a number of organisations and is often incorporated in governmental policies for the accessibility of websites in a number of countries.

A new version of WCAG 2.0 was published in 2008 [4], incorporating substantial changes in its structure when compared to WCAG 1.0 [3]. The new version aimed to improve the testability of its conformance criteria. WCAG 2.0 includes five layers of structure:

- Principles: the top level of structure are the four principles of perceivable, operable, understandable and robustness
- Guidelines: the next level of structure at the 12 guidelines, which set out the basic goals that web authors should follow to provide accessible content
- Success Criteria: for each Guideline, success criteria are provided. The Success Criteria are organized into three levels: A (lowest level of conformance), AA, and AAA (highest level of conformance)

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- Techniques: for each Success Criterion, a variety of techniques are offered on how to meet the Success Criterion.
- Examples: for most Technique one or more examples provided of how to implement the technique; in some cases no examples are provided.

The Techniques are an important innovation in WCAG 2.0 and constitute the practical support to guide developers in how to produce accessible code. They can also be used as evaluation criteria to determine whether particular levels of WCAG 2.0 conformance have been achieved. Two different types of Techniques include sufficient and advisory. Sufficient techniques are those that if they are successfully applied, will suffice to meet a particular Success Criterion. Advisory Techniques "go beyond what is required by the individual success criteria and allow authors to better address the guidelines. Some Advisory Techniques address accessibility barriers that are not covered by the testable success criteria" [6].

WCAG 2.0 also describes the Techniques as informative, in contrast to the Guidelines and Success Criteria that are normative for conformance. This means that developers are not required to follow particular Techniques, if they find other ways to achieve the Success Criteria. So the techniques are sufficient, but not necessary. Other techniques might achieve the same ends. However, although they are not designated as normative, the Techniques are the only elements in WCAG 2.0 that contain concrete information on how to implement accessible web content, through the explanations of the Techniques and the related Examples.

Despite the weight given to the Sufficient Techniques in WCAG 2.0, little evidence is provided as to why and how they are sufficient, for example it is not clear what evidence there is from disabled users to support the claims of the Sufficient Techniques. One source of such evidence might be published literature, as is used by the usability guidelines developed by the US Department of Health and Human Sciences [2]. However, in the case of web accessibility, there is not a substantial body of published research evidence to draw on. Therefore it is important to create such a body of evidence based on actual experience of disabled users with the web to support the WCAG 2.0 Techniques.

In this paper, we present a methodology for the efficient collection of data from disabled users to provide such evidence. The methodology involves setting up a small website in which the different techniques to meet the Success Criteria can be used. Disabled users are asked to go to the site, undertake small tasks and answer specific questions about the behaviour of the site, or their expectations of its behaviour, to test whether the techniques are creating content in the anticipated ways. Users are also asked to give a rating of their confidence in the behaviour of the website and how easy or difficult it was for them to complete the task and/or understand the relevant information on the site. Finally, information is collected about the operating system, user agent and assistive technologies that users have, so that differential effects of each of these layers of technology can be investigated. Crowdsourcing [1] is used to recruit disabled people who are interested in participating in evaluation of websites. We demonstrate the successful use of this methodology with a study of one particular Success Criterion in WCAG 2.0, Success Criterion 2.4.4.

The rest of the paper is organized as following: Section 2 describes Success Criterion 2.4.4 and the techniques provided by WCAG 2.0 to meet this criterion. Section 3 describes the methodology and its particular implementation for this study. Section 4 provides the results of the study. Section 5 provides discussion, both of the particular study presented and the methodology, and plans for future work.

## 2 WCAG 2.0 Success Criterion 2.4.4: Link Purpose (In Context)

In the study presented in this paper we analyse the sufficient techniques associated with Success Criterion (SC) 2.4.4 of WCAG 2.0. SC 2.4.4 states:

*"the purpose of each link can be determined from the link text alone or from the link text together with its programmatically determined link context, except where the purpose of the link would be ambiguous to users in general" [4].*

For the users this criterion is intended to ensure that they can identify where a link will lead by the relationships between the link, its text or the context in which it is placed. An important aspect is that this implies that the user must know where a link will lead before following that link to its target web page.

For this SC, there are 15 sufficient techniques listed. Of these techniques, any one technique should be sufficient to meet the SC. There are 3 techniques that are General Techniques, meaning they are technology agnostic, allowing them to be implemented in any technology. There are 8 HTML technology specific Techniques, 2 Techniques for Flash, 1 Technique using Cascading Style Sheets (CSS) and 1 for scripting languages (e.g. Javascript). For each of these Techniques there is one or more example implementation of the Technique.

## 3 Method

### 3.1 Participants

Messages were sent to a number of online discussion lists of visually disabled computer users and the panel of visually disabled people with work with the Human Computer Interaction Research Group at the University of York. Participants were offered a small compensation for their effort in completing the evaluation (a gift voucher for a major retailer worth approximately USD 15).

Within one week 25 people had responded and provided complete or nearly complete data for the study. 13 were men, 11 were women (1 respondent did not disclose his or her personal details). 4 were aged 18-20, 7 were aged 21-30, 4 were aged 31-40, 5 were aged 41-50, and 4 were aged 51-60. 22 stated that they were blind, 3 that they were partially sighted. 20 people use a screen reader, 1 uses a screen magnification program, and 3 use both screen reader and screen magnification programs.

On average the respondents have used computers for 11-20 years and rated their expertise as "competent" (on a 5-point Likert item from 1 = novice to 5 = expert). On average they use the Internet for 11-20 hours each week. All of the respondents use a

version of Microsoft Windows operating system and the majority uses a version of the Microsoft Internet Explorer web browser.

### 3.2 Website to Present the Techniques

A website for a fictitious entertainment venue was developed, the North Yorkshire Palladium. This website consisted of several webpages, one web page for each Sufficient Technique tested. Each webpage was designed to contain content from the entertainment venue along with and one test link implemented to the specification of one Sufficient Technique.

For the implementation, the QuestionPro survey engine[1] was used to integrate the webpages into a structure that allowed the researchers to ask the participants to undertake a specific task on the webpage, identifying to where a link would lead, and then answer a set of questions regarding the task. This approach was taken to make the development of these test webpages as lightweight, flexible and efficient as possible

The researchers have worked with QuestionPro to undertake surveys with many hundreds of disabled users without encountering accessibility problems, but to ensure that the implementation used in this study did not cause accessibility barriers, a pilot study with two expert screen reader users was undertaken.

The use of QuestionPro did limit the type of techniques that could be tested. Due to QuestionPro only allowing users creating surveys to add content using standard HTML/CSS techniques after a standard header, it was not possible to test Flash based techniques (FLASH7, FLASH27)[2], scripting techniques (SCR30) and one general technique (G189). As such, there were 11 test pages created for different techniques with 11 different tasks being undertaken by users.

In all cases but those specifically noted, the researchers used the first Example in each Technique as a template for the implementation of the test link. The following are descriptions of the 11 Techniques and their implementation presented in the order in which they are referenced in the document How to Meet WCAG 2.0[10].

#### Technique G91: Providing link text that describes the purpose of a Link

This technique was implemented using clear text embedded in an anchor tag in HTML.

```
<a href="#">History of the North Yorkshire
Palladium</a>
```

#### Technique H30: Providing link text that describes the purpose of a link for anchor elements

This technique was implemented using the second example implementation as its first example implement is functionally equivalent to G91. Indeed the first example of both G91 and H30 are identical in implementation detail. This technique was

[1] www.questionpro.com
[2] Labels correspond to WCAG technique numbering.

implemented by placing the target of the link in the alternative text of an image element encapsulated in an anchor element for a link.

```
<a href="#"><img src="ny_palladium.jpg" alt="View the
gallery of the North Yorkshire Palladium" /></a>
```

**Technique H24: Providing text alternatives for the area elements of image maps**

The image map used to implement this technique consisted of an image of the seating plan for the North Yorkshire Palladium, divided into 3 areas, with 1 link leading to each area. For each link, the area that was the target destination of the link was labelled in the alternative text attribute for the area.

```
<img src="/ny_palladium_seating.gif" alt="Seating plan
of the North Yorkshire Palladium. Select an area for
more information on that area." usemap="#SeatingPlan"
/>
<map name="SeatingPlan" id="SeatingPlan">
<area ... alt="Plan of the Upper circle" />
<area ... alt="Plan of the Royal Circle" />
<area shape="rect" coords="4,192,397,368" href="#"
alt="Plan of the stalls" /></map>
```

**Technique G53: Identifying the purpose of a link using link text combined with the text of the enclosing sentence**

The link implemented in this technique, “click here”, requires the preceding text in the same sentence to identify that it points to a page about becoming a member of the North Yorkshire Palladium.

```
<p>To become a member of the North Yorkshire
Palladium, <a href="#">click here</a>.</p>
```

**Technique H33: Supplementing link text with the title attribute**

This Technique was implemented with a link text saying “It’s behind you”, but its purpose is complemented by the title attribute “Find out more about this year’s pantomime”.

```
<p><a href="#" title="Find out more about this year's
pantomime">It's behind you!</a></p>
```

**Technique C7: Using CSS to hide a portion of the link text**

A link was implemented with a long text. Part of this text was hidden with CSS scripting. The link only showed visually “Lennie & George: Steinsbeck’s Greatest

Creations", while the text "A news story on the upcoming production of Mice & Men" is hidden by CSS.

```
HTML:
<a href="#"><span class="wcag_links_span">A news story
on the upcoming production of Mice & Men</span> Lennie
& George: Steinbeck's Greatest Creations</a>

CSS:
#wcag_links a span { height: 1px; width: 1px;
position: absolute; overflow: hidden; top: -10px; }
```

**Technique H77: Identifying the purpose of a link using link text combined with its enclosing list item**

The link text "More information" has its purpose described by the combination of its text and the content in the list item in which it is enclosed. This link brings more information about the production "Peter Pan".

```
<ul>
  <li>The Crucible - More information</li>
  <li>Peter Pan - <a href="#">More
  information</a></li>
  <li>A Midsummer Night's Dream - More
  information</li>
</ul>
```

**Technique H78: Identifying the purpose of a link using link text combined with its enclosing paragraph**

This Technique was implemented by means of a link as a separate statement at the end of the paragraph, with the context of the link being provided in the enclosing paragraph.

```
<p>The North Yorkshire Palladium has recently been
nominated for two prestigious Luvvie Awards. ...The
awards are voted on by the general public.
<a href="#">Find out more information as well how to
vote</a>.</p>
```

**Technique H79: Identifying the purpose of a link using link text combined with its enclosing table cell and associated table headings**

The link with text "£60" needs to be associated with a vertical header describing the categories of membership (Silver) and the place in which the seat at this price are located (Royal Circle). Failing to identify either of these would cause a misunderstanding about the discounts or where the seat is located.

```
<table>
<tr><td> </td>
  <th scope="col">Bronze</th>
  <th scope="col">Silver</th>
  <th scope="col">Gold</th>
</tr>
<tr>
  <th scope="row">Upper Circle</th>
  <td>&pound;10</td>
  <td>&pound;40</td>
  <td>&pound;70</td>
</tr>
<tr>
  <th scope="row">Royal Circle</th>
  <td>&pound;30</td>
  <td><a href="#">&pound;60</a></td>
  <td>&pound;90</td>
</tr>
<tr>
  <th scope="row">Stalls</th>
  <td>&pound;20</td> <td>&pound;50</td>
  <td>&pound;80</td>
</tr>
</table>
```

**H80: Identifying the purpose of a link using link text combined with the preceding heading element**

This technique was implemented with a link in a list of "benefits of becoming a member". The link text has to be read considering the preceding heading, in order to convey the message that "10% off food and drink" was only given to members.

```
<h3>Benefits of becoming a member</h3>
<ul>
  <li>...</li><li>...</li>
  <li><a href="#">10% off food and drink at the Bar
  whenever you visit.</a></li>
  <li>...</li><li>...</li>
</ul>
```

**Technique H81: Identifying the purpose of a link in a nested list using link text combined with the parent list item under which the list is nested**

The link used for this technique pointed to a page describing information about the production "To Kill a Mockingbird". It was nested within a list of current productions, and within an inner list with specific links for "To Kill a Mockingbird" with text "About this production".

```
<li>To Kill A Mockingbird (11th February – 26th
February)
<ul>
  <li><a href="#">About this production</a></li>
  <li>Meet the cast</li>
  <li>Book tickets</li>
</ul>
</li>
```

## 4 Results and Discussion

The results from the remote evaluations are presented in Table 1. This table presents the techniques in order of percentage of participants who succeeded at the task. The participants were asked to record their confidence in their answer regarding the link destination and the difficulty they had in determining that destination. The average mean confidence rating, with the value of 1 indicating high confidence and 5 indicating very low confidence are presented in column 3. Similarly, the mean difficulty of the task, where 1 indicates that the task was very easy and 5 indicates very difficult, is presented in column 4.

There was a highly significant difference between the percentage of participants who correctly identified the link target destination for the different techniques (chi-square = 76.01, df = 10, $p < 0.01$). Assuming that the target is to have 100% of users be able to determine the link target destination through the conformance to SC 2.4.4, from this table we see that only one technique comes close to meeting that target. Only the general technique, G91, where the link is implemented with plain text in an anchor element succeeds for close to all participants. If we relax the criteria for deciding if the technique has been a success in meeting the SC to be a success rate greater than 75%, then the first 7 techniques presented in the table are successful.

**Table 1.** Results from the evaluation of Success Criteria 2.4.4 techniques

| Technique | % of all participants giving appropriate information (Rank) | Mean confidence rating (Rank) | Mean difficulty rating (Rank) |
|---|---|---|---|
| G91 | 96.0 (1.0) | 1.48 (1.0) | 1.25 (1.0) |
| G53 | 92.0 (2.0) | 1.55 (4.0) | 1.71 (3.0) |
| H30 | 88.0 (3.5) | 2.18 (8.5) | 1.85 (5.0) |
| H77 | 88.0 (3.5) | 1.91 (5.0) | 1.91 (7.5) |
| H81 | 84.0 (5.0) | 1.52 (3.0) | 1.86 (6.0) |
| C7 | 80.0 (6.0) | 1.50 (2.0) | 1.55 (2.0) |
| H78 | 76.0 (7.0) | 1.94 (6.5) | 1.78 (4.0) |
| H24 | 64.0 (8.0) | 1.94 (8.5) | 1.94 (9.0) |
| H79 | 44.0 (9.5) | 3.09 (11.0) | 2.64 (10.0) |
| H80 | 44.0 (9.5) | 2.18 (8.5) | 1.91 (7.5) |
| H33 | 20.0 (11.0) | 2.60 (10.0) | 2.60 (11.0) |

There are several very interesting features in these results. First, it is notable that a technique that relies on the inclusion of a standard HTML attribute, that of the title attribute in a link, performed the worst out of all the techniques, even those that are much more complicated conceptually. This perhaps indicates that users do not use the title attribute in that way, or have the reading of the title attribute turned off in their assistive technology configurations. The poor showing of this technique, with only 20% of users understanding the target of the link, and with the average difficulty for that technique being the highest of all techniques, indicates that this is a very poor technique to be recommending to web developers to use.

In contrast, one of the key techniques widely reported to be very problematic does not confuse users as often as expected. The target destination of the "click here" link in technique G53 was correctly understood by users 92% of the time from using the surrounding context. While falling short of the 100% goal, this result indicates that users have adapted to this commonly used technique, developing strategies to address the apparent shortcomings of the link itself, and in this environment, was successful.

There is an interesting situation that presents itself when looking at technique H30, where the link destination is the alternative text of the image encapsulate within a link anchor element. The participants were successful 88% of the time, lower than one would expect for such a simple technique. Further, the users exhibited extremely low confidence regarding their answers, and had moderately high difficulty in obtaining the correct answer. It is hypothesized that this is due to the users having a specific mental model regarding how alternative text should be used, specifically that it is used to describe an image. It is possible that the users, having encountered a destination for the link instead of a description, were unsure as to what the text referred. This hypothesis warrants further investigation, possibly through the use of retrospective protocols to understand the mental models the users bring to surfing the web, and specifically the use of links on the web.

## 5 Conclusions and Future Work

This paper has presented a methodology for evaluating the success of web design and implementation techniques relating to WCAG 2.0 Success Criteria. This methodology is intended to be a lightweight, flexible means of obtaining data through remote evaluation to ensure that techniques are contributing to the overall goal of making the web accessible to all people with disabilities.

This methodology was applied to the techniques associated with the Success Criterion 2.4.4 relating to users identifying link destinations. The results indicate that only one technique, that of having plain text contained within an anchor element, meets the criterion of creating an accessible link almost 100% of the time for visually disabled users. Other techniques met with varied levels of success. However, a number of simple to implement techniques resulted in either inaccessible links or links about which the users had low confidence regarding their destination

For the future, it is important that the web accessibility community begin to take an empirical, evidence-based approach to WCAG 2.0 Techniques, and work to identify which techniques work best for users.

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