

SIGNS AND WARNINGS TO DETER CHILDREN FROM ENTERING SPACES WITH ELECTRICAL HAZARDS

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1. Summary

There are service rooms within many larger buildings which contain potentially hazardous electrical equipment. The Municipal Electrical Association retained Behavioural Team, A Corporation to refine signs which warn of such hazards and to provide validation data on the effectiveness of these signs. Because young children represent the most challenging audience for these signs, this project addresses their reactions.

The project started with a series of signs analogous to others found useful in open-air yards. These depicted in simplified illustrations (1) the view outside the room with the door closed and (2) three signs showing the interior but with different types of equipment shown.

After pilot tests on preliminary signs conducted with children in small-groups and as individuals, a number of changes were recommended, particularly to enhance the communication of hazardousness and the consequences of entry. After a second round of pilot testing, two signs were chosen for large-sample testing which represented the exterior (door closed) view and a representative interior view. A questionnaire suitable for self- or examiner-administration was also pilot tested.

Reactions to these two signs were solicited from 262 children approximately equally distributed in grades 1 through 4 in two City of Toronto schools. Pre-literate children and any child unable to complete a questionnaire without help were individually interviewed and children literate in English were given the questionnaire by group administration.

Both the interior and exterior signs resulted in 99% of children indicating that they felt that it was dangerous to enter a room with either sign on the door. This establishes a worst-case estimate for the number of children who understand the intent of the sign.

On the basis of this evidence, it is recommended that these signs be endorsed by the MEA for use as warnings against entering electrical service rooms.

2. Introduction

In April, 1994, the Municipal Electrical Association (MEA) hired Behavioural Team to develop signage intended to instill a perception of hazardousness in viewers. The warning had to achieve its communication goal for everyone who might be exposed to electrical service rooms without close adult supervision. It was deemed of practical significance to establish only that school age children — particularly those who are pre-literate and poorly literate — would respond appropriately to the signage.

3. Development and pilot tests

Some preliminary signs were contributed by Paul Hader's group at Ontario Hydro. These are shown in Appendix A.

For pilot tests, 23 children attending the St. Alban's Boys and Girls Club summer camps were tested. Their ages were 6-11 and they had completed grades kindergarten through fifth. They were tested in groups of three or four. This provided a reasonably rounded preliminary sounding of children.

Some observations arose from this first test.

1. All of these children recognized from the signs the imperative to avoid entering the rooms because they contain hazards.
2. The element which propels the strongest sense of danger is the lightning bolt image followed by a do-not-enter element, reasonably conveyed at present by an X over the boy drawn in a posture of reflexive recoil. Therefore, it was concluded that the bolt should be more prominent, bordered in red with a yellow fill, and over a darker background for greater visual contrast.
3. No more than two children (and these were older kids) could reliably associate the bird with hazards or with Hydro educational materials. A few more children recognize the logo as a Hydro symbol and a few more yet, perhaps eight in all, sense that it is meant to picture a mains plug.
4. On the door should be a picture which conveys an interpretation of the contents of the room for purposes of scaring the kids, satisfying their curiosity, and to generally reduce the number of mysteries in a child's life. An "interpretation" does not need to be a true picture of the gear in the room; the

children “said” it should look something like a domestic fuse panel with discrete wires visible running off in different directions.

5. Not many young children — perhaps 25% — have personal experience of shocks from 115 volt sources.

As a result of these tests it was recommended that...

1. An explicit message should be present, “This room contains...”
2. A picture, something of a cross between the two-panel and water-cooled transformer, should be used.
3. The same sign can be installed inside the room.

The revised test signs were developed and tested on a further sample of 24 children. In addition, a draft version of the questionnaire were administered in order to see how well children could react to it. Children showed very high levels of comprehension of the sign and were able to respond appropriately — whether spoken by an interviewer or self-administered — to the questionnaire.

Following discussions with the MEA, a few changes were made to the signs and to the questionnaire. MEA approval was secured to proceed to get Board of Education final authorization to test children in schools with these materials.

4. Validation

4.1. Sample and testing

The validation tests were conducted on children in grades 1 through 4 of the Hillcrest and Brown elementary schools in Toronto. Of the 262 children in the study, 145 came from Hillcrest and 117 were from Brown. These schools serve children from a range of cultural, economic, racial, and language backgrounds typical of an urban setting. Three of the dozen classes visited were French immersion. But results did not differ enough from other classes to separate these children statistically. Half a dozen children were recent immigrants from non-anglophone countries who needed individual interviews while their classmates were able to respond to the questionnaire in group administrations.

In the presentation of the questionnaire, no mention was made of “Hydro” or any affiliation with an electrical association. No child was offered stimulative probes which in any way identified electricity or even any hazard as being present in the room depicted in the signs. A typical probe was, “Do you think there are *bananas... shoes... or what* in the room?”

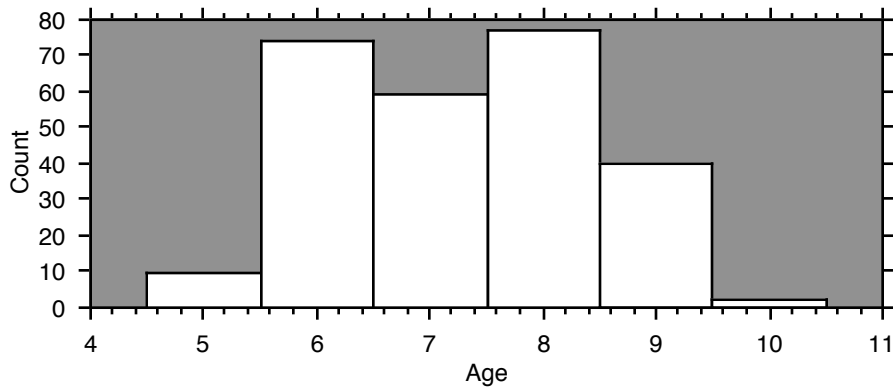
[It is part of professional obligations in the treatment of participants by Psychologists to provide a de-briefing to participants. To fulfill this ethical obligation, copies of this report will be placed in the school libraries and accessible to parents and school authorities. Likewise, any parent or child may contact the authors for further information.]

It is important to note that *all* children in class at the time of testing in *all* classes were administered the test and scored for accuracy. *No selection what so ever took place based on language or reading ability other than only children who were present in class were tested.* Not a single questionnaire was discarded from the analysis.

The numbers of children tested with each of the two kinds of sign and their school grade are shown in the table below.

| | Interior | Exterior | Totals |
|---------|----------|----------|--------|
| Grade 1 | 31 | 33 | 64 |
| Grade 2 | 33 | 28 | 61 |
| Grade 3 | 32 | 40 | 72 |
| Grade 4 | 27 | 38 | 65 |
| Totals | 123 | 139 | 262 |

The ages of the children (at their most recent birthday) are shown in the chart below.



4.2. Test procedure

It should be recognized that this test represents a worst-case or conservative estimate of the effectiveness of these signs. Not only do the children (1) need to understand the signs, but they must (2) correctly communicate their understanding to the researchers through spoken words in an interview or by written self-report on the questionnaire.

They must be cooperative. Unlike operational settings, they must respond within the time and stress constraints of the schoolroom test setting. Thus they need to be correct and accurate on all counts in order to be scored as understanding the sign in the research setting.

One child gave the impression of dissembling for his own amusement and/or for his need for rebellion. His teacher volunteered that this child sometimes behaves in this contrarian way. Never the less, his responses

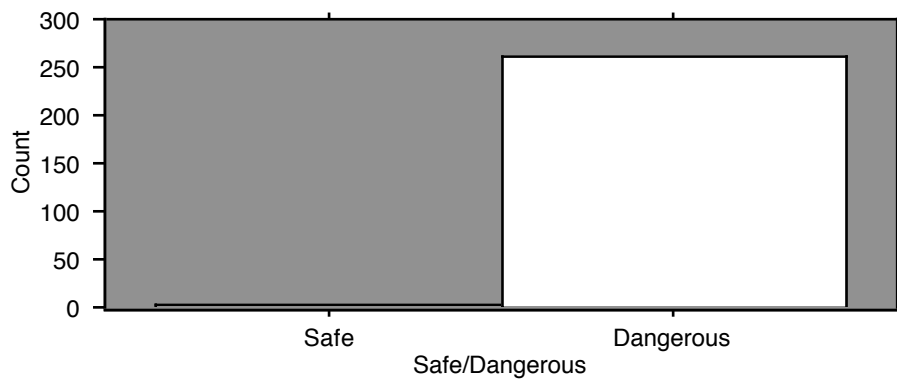
could not be discarded; one of the two safe-to-enter answers originates with this boy.

4.3. Results

Do the children believe it is *safe* or *dangerous* to enter a room which has one of these warning signs on the door?

Overall for grades 1 through 4, 0.8% (2 out of 262) felt it was *safe* and 99.2% felt it was *dangerous*.

The two children who thought it was safe are in grade 1 and one was exposed to the interior and one to the exterior sign. In as much as there is reason to believe from observation and from his teacher's comments that one of these children was dissembling, it may be concluded that a best estimate of misunderstanding of the hazard of entry among children *in their first month* of grade 1 is under 3%.



There were ten children who were 5 years old in the sample. All answered *dangerous*.

Do the children know what the sign "means"?

Both the interior and the exterior (door closed) views imparted a sense of danger to the children. But the interior view was better able to help the child identify the hazard as an electrical one.

| | Interior | Exterior | Totals |
|----------------|----------|----------|--------|
| Danger/electr | 34 | 22 | 56 |
| Danger/other | 2 | 0 | 2 |
| Neutral | 4 | 3 | 7 |
| [No ans] | 3 | 5 | 8 |
| Danger/generic | 80 | 109 | 189 |
| Totals | 123 | 139 | 262 |

For children in grade 1, the difference was particularly large. Only about 10% of those tested with the exterior view understood by reading, recognizing the Ontario Hydro logo, grasping the significance of the small sign appearing on the door in the picture in the sign, knowing by guessing, or knowing by pure inference, that the hazard was electrical.

| | Interior | Exterior | Totals |
|----------------|----------|----------|--------|
| Danger/electr | 13 | 3 | 16 |
| Danger/other | 1 | 0 | 1 |
| Neutral | 4 | 3 | 7 |
| [No ans] | 3 | 2 | 5 |
| Danger/generic | 10 | 24 | 34 |
| Totals | 31 | 32 | 63 |

Could the children characterize the contents of the room?

Overall, children did sense that the equipment in the room was electrical. But grade 1 children were again poorer in this judgment when presented with the exterior (door closed) view.

| | Interior | Exterior | Totals |
|----------------|----------|----------|--------|
| Danger/electr | 107 | 108 | 215 |
| Danger/other | 5 | 8 | 13 |
| Neutral | 3 | 4 | 7 |
| [No ans] | 2 | 0 | 2 |
| Danger/generic | 5 | 19 | 24 |
| Totals | 122 | 139 | 261 |

[One answer was undecipherable.]

5. Recommendations

We recommend that the MEA committee endorse the signs tested for rooms which contain hazardous electrical equipment. It is our opinion that signs which are similar except for minor variations in the picture of the equipment in the room are not likely to be materially less effective.

Choice of sign

Both the interior and the exterior sign convey the message intended comparably well. However, the data shows that younger, pre-literate children are able to better sense the nature of the hazard from the interior sign which illustrates the interior gear and shows the lightning glyph and “shocked” child. Moreover, their curiosity is better addressed by the interior sign, thereby reducing a possible motivation to enter the room. Therefore, it is recommended that the interior sign be favoured for use.

Eye height

The signs should be placed at a reasonable height which would serve both young and mature viewers. A reasonable Human Factors standard of height may be based on the following table of eye heights taken from Dreyfuss’ *Humanscale* standards, published by MIT Press.

| | | |
|----------------|----------------------|-----------------------------|
| | average adult | 161 cm (just over 63 |
| inches) | | |
| | youth of 12 | 141 cm |
| | youth of 10 | 132 cm |
| | youth of 8 | 120 cm |
| | youth of 6 | 107 cm |

For an audience of all ages, a height of 125 cm (just over 49 inches) would be reasonable. If the group is special in some manner, a height tailored to the cohort would be better. For an elementary school or in the vicinity of a childrens’ play area, a height of 115 cm might be chosen.

Sign size

The size of the tested signs was roughly 110 mm wide and 300 mm high. They were printed on a bright white letter-sized sheet and were viewed on a schoolroom desk. This stimulus configuration resulted in the favourable data reported here.

The tested size is large enough to be read by any child with ordinary eyesight at a distance beyond an arm's length reach, assuming reasonable lighting.

6. Appendices

6.1. **Appendix A: *Interior* and *Exterior* tested signs**

6.2. Appendix B: Questionnaire