

Teaching students to recognize and deal with Situations of Uncertainty at uncontrolled crossings

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Abstract

A significant aspect of Orientation and Mobility is teaching travellers with visual impairments systematic methods to access their environment and evolving these methods to match the complexity of the world around us. At crossings where there is no traffic signal or stop sign, there are increasingly many situations where it is no longer best practice to assume it is clear to cross when quiet, or simply re-route and avoid. This article explains a step-by-step method O&M specialists can use for teaching travellers with visual impairments how to determine if a crossing is a "Situation of Uncertainty" or a "Situation of Confidence" by helping them develop an intuitive understanding of their own crossing time; learn to intuitively and accurately compare their crossing time with the warning time of approaching vehicles; and judge whether or not they can be confident that it is clear to cross whenever it is quiet in that situation. Following this, the article discusses a method that learners can use to determine the level of risk at any given crossing so they can decide if the level of risk is acceptable or unacceptable to them.

Keywords

Orientation and Mobility, road crossings, low vision and blind.

Introduction

Amid the ever-increasing complexity of navigating pedestrian travel, it is important that our Orientation and Mobility curriculum includes teaching travelers with visual impairments (hereafter referred to as the "student") to cross streets with no traffic signal or stop sign using the most up-to-date methods. This article explains a step-by-step method O&M Specialists can use for teaching students how to determine if they have enough warning of approaching vehicles to be confident it is clear to cross whenever it is quiet, rather than following the inaccurate assumption that "all-quiet" is synonymous with "all-clear" or "safe". This can be done by helping them develop an intuitive understanding of their own crossing time; learn to intuitively and accurately compare their crossing time with the warning time of approaching vehicles; and judge whether or not they can be confident that

it is clear to cross whenever it is quiet in that situation. Consistency is encouraged with the use of a flowchart (Figure 1) when analyzing situations. Students are also provided with a guideline to help determine the level of risk of crossing in Situations of Uncertainty and decide if they are willing to accept that risk.

At crossings with no traffic signal or stop sign, such as at intersections with stop signs for one street but not the other, and at roundabouts and channelized right-turning lanes, there are many situations where, even when it is quiet, the approaching vehicles cannot be heard with enough warning for people to be confident that it is clear to cross (Wall Emerson and Sauerburger, 2008). For example, if people need 7 seconds to cross a given street or lane and they cannot hear approaching vehicles when it is quiet until those vehicles are less than 7

seconds away, they cannot be confident that it is clear to cross because even when it is quiet, there could be an undetected vehicle approaching that could reach them during their crossing. These situations are called situations of uncertainty of gap judgment (Barlow, Bentzen, Sauerburger, & Franck, 2010) – we will refer to them here simply as “Situations of Uncertainty.” People who use their vision at crossings with no traffic control are also in Situations of Uncertainty when they cannot see approaching vehicles with enough warning to be confident that it is clear to cross. Situations where a person CAN hear (or see) all approaching vehicles with enough warning to be confident it is clear to cross whenever it is quiet (or when no vehicles are visible) are called Situations of Confidence.

Often, the vehicles can be heard with enough warning when approaching from one direction but not the other. For example, the time needed to cross and get out of the way of vehicles approaching in the nearest side of the street is usually half the time for getting out of the way of vehicles coming from the other direction, so the warning time needed for vehicles in the first half of the street is less. And sometimes there is a hill or a bend in the road that blocks the sound of vehicles coming from one direction but not the other. When the warning time for vehicles approaching from one direction is insufficient, the crossing presents a Situation of Uncertainty regardless of whether vehicles coming from the other direction are heard or seen with enough warning.

It is important that our O&M curriculum includes teaching students to recognize Situations of Uncertainty and be able to analyze the risks of crossing in these situations. And because the situation at a given crossing can change from day to day and sometimes even minute to minute, whenever people plan to cross where there is no traffic signal or stop sign, they should take some time to observe and judge whether it is a Situation of Uncertainty at that time. For efficiency and skill generalization, this judgment should be made readily, without having to use any formal assessment with counting or timing. Following is a

brief outline of a systematic method for teaching students to recognize Situations of Uncertainty, and analyze the risk of crossing in these situations.

Process for teaching students to recognize Situations of uncertainty

The process for training described in this article can be used by students of all ages who are ready to begin learning concepts and skills needed for crossing streets. It is best to provide this training after the student understands how vehicles move at uncontrolled crossings and the concept of crossing when they can be confident that it is clear to cross. This includes understanding that to be confident that it is clear to cross, there needs to be sufficient warning of approaching vehicles detected by either their auditory or visual sense. Once students are ready for the training, the following step-by-step process can be used for teaching them to recognize Situations of Uncertainty.

First step: Help students develop an intuitive understanding of their own crossing time.

To be able to recognize Situations of Uncertainty readily, students need an intuitive understanding of the time they need to cross streets. The following explains the process for developing an intuitive understanding of the time needed for crossing a street; this process should be adapted for helping students also develop an intuitive understanding for crossing half of that street, as well as streets of different widths.

- After students have had the opportunity to cross the street, tell them that you are going to demonstrate the time needed for their crossing. Start by asking them to imagine crossing the street, beginning when you start a stopwatch.

- When the stopwatch indicates that the time which students need to cross has passed, tell them that is when they would have reached the other side. For example, if their crossing time is 7 seconds, have them imagine starting to cross the street while you start a stopwatch. Seven seconds later, tell them they would have reached the other

side at that time.

- Next, ask students to imagine crossing the street again, but this time have them report to you when they start their imaginary crossing, and when they think they would have reached the other side. Make sure they are actually imagining the crossing, not counting

- Start a stopwatch when students report that the imaginary crossing has begun and stop the watch when students report that they think they would have reached the other side.
- Tell students whether they were accurate. For example, if a student needs 7 seconds to cross and only 5 seconds have passed from when they started their imaginary crossing until they say they imagined that they have reached the other side, tell them that they needed more time than they thought they did. Students who are having difficulty estimating the time may benefit from having you demonstrate it again until they are ready to try it themselves.

- This exercise continues until students can consistently estimate when the time needed to cross the whole street has passed (give or take a second). The process should be repeated for developing an intuitive understanding of the time needed for crossing half the street. Most people can learn this in 5-10 minutes.

Second step: Help students learn to intuitively compare the crossing time with the warning time of approaching vehicles accurately.

- While standing at the edge of the crossing, have students wait until it is quiet. If there is a steady ambient sound that is considered part of the conditions of that situation (such as the sound of an air conditioner or fountain), “quiet” would mean there are no temporary extraneous noises that could mask the sound of the approaching vehicles. If students are using their vision, have them wait until they can see no approaching vehicles (that is, it appears to be clear).

- Once it is quiet / clear, have students listen or watch for traffic, and report the first detection of

something that they think might be an approaching vehicle. Explain that they should not wait until they are sure it is a vehicle before they report that they think they heard (or saw) something coming. Tell them that once the vehicle passes, they should report whether they think the warning time of the vehicle (the time from when they detected it until it arrived) is longer than, shorter than, or about the same as the time they need to finish crossing the street (or that part of the street).

- If they are using their hearing, they can report when they think they hear a vehicle approaching from either direction. If they are using their vision, they should look in just one direction at a time and assess the situation from that direction, then turn and assess the situation from the other direction. They may need training later to be able to efficiently look for vehicles from one side to another (Fazzi and Barlow, 2018, Barlow, Bentzen, Sauerburger and Franck 2010).

- Once students report that they suspect that they hear (or see) something that might be an approaching vehicle, start a stopwatch and ask them if it was quiet when they heard that vehicle. If they think it was quiet and you think it was not, they may need some further training to be aware of what “quiet” means.

- Regardless of whether it was quiet when they heard the vehicle, continue timing its approach and stop the watch when it passes in front of the student. Do not report the time until after the student guesses whether the warning time was longer than their crossing time.

- After the vehicle passes, ask students to guess if the warning time (detection-to-arrival time) for that vehicle was shorter than, longer than, or about the same as their crossing time for that part of the street. For example, if the vehicle was approaching in the first half of the street, students need to guess whether the warning time for that vehicle was longer than / shorter than / about the same as the crossing time for that half of the street. If the vehicle was approaching in the last half of the street, students compare the warning time of that

vehicle with the time needed to cross the entire street.

- Tell students if they were correct.
- Repeat until students can accurately judge

whether the warning time was longer than, shorter than, or about the same as the time they need to cross in front of vehicles coming from that direction.

NOTES:

1. If it was not quiet when they reported hearing an approaching vehicle, after they guess whether the warning time was longer than their crossing time, tell them whether they were correct or not. Then explain that since that vehicle was not heard when it is quiet, it cannot be used as a sample to help them determine if approaching vehicles are heard with enough warning time when it is quiet. If it was heard with less warning than other vehicles, it is a terrific opportunity to discuss the effect of masking sounds making vehicles harder to hear and reducing their warning time.
2. If they report hearing a vehicle when it is quiet but there is no vehicle approaching, praise them for reporting that something might be coming, and reset the watch to wait again for a vehicle. If you do not acknowledge or praise their reporting, the next time they may not report as soon as they think there might be a vehicle coming, and instead will wait until they are more certain.

Third step: Have students conclude whether this is a Situation of Uncertainty.

Once students have sampled the warning times of enough approaching vehicles, they can determine whether they are in a situation where they can be confident that it is clear to cross whenever it is quiet (or whenever they see no vehicles approaching), or a Situation of Uncertainty. They should be aware that they are not assessing the crossing once for all time, they are merely assessing the situation that exists for the crossing at that moment, and situations can change drastically at each encounter.

If students were not able to sample enough vehicles that approached when it was quiet (either because it never got quiet, or because there were not enough vehicles), they are, by definition, in a Situation of Uncertainty - they cannot be sure that it will be clear to cross whenever it gets quiet (or, if they are using their vision, it may not be clear to cross whenever they see no vehicles approaching).

Once they have sampled enough vehicles that approached when quiet, they can use the following flowchart to determine whether they are in a Situation of Uncertainty. For vehicles approaching in the first half of the street, and for vehicles approaching in the last half of the street, they need to ask themselves:

- Was the warning time of any vehicle shorter than the crossing time for that part of the street?
 - If YES, then this is a Situation of Uncertainty for vehicles approaching from that direction.
 - If NO, then consider the range of warning times:
 - Was the range of warning times close to the crossing time? That is, was the warning time of any of the vehicles close to the crossing time?
 - If YES, then this is a Situation of Uncertainty for vehicles approaching from that direction.
 - If NO, then consider the spread of the range:
 - Was the spread of the range of warning times broad? For example, a range of warning times being 12 to 25 seconds is broad, whereas a range of 12-15 seconds is not.
 - If YES, then this is a Situation of Uncertainty for vehicles approaching from that direction.
 - If NO, then this is a Situation of Confidence for vehicles approaching from that direction.

In other words, you can be confident that it is clear to cross when quiet if the range of warning times sampled is narrow and not close to the crossing time.

If there is a Situation of Uncertainty for vehicles from either direction, it is a Situation of Uncertainty for the crossing at that time. That is, a Situation of Confidence exists only when there is a Situation of Confidence for vehicles from both directions.

Make sure students realize that crossings that present a Situation of Confidence at one time may present a Situation of Uncertainty at another. When a crossing outside of Philadelphia where a blind man and his guide dog were killed in 2010 was analyzed a few weeks after his death, it was a Situation of Uncertainty on a Friday afternoon, but a

Situation of Confidence on a Saturday evening. If he had analyzed the situation and its risks before starting to cross, he might have decided the risks were not acceptable, and crossed a few blocks away where an accessible pedestrian signal had been installed at his request.

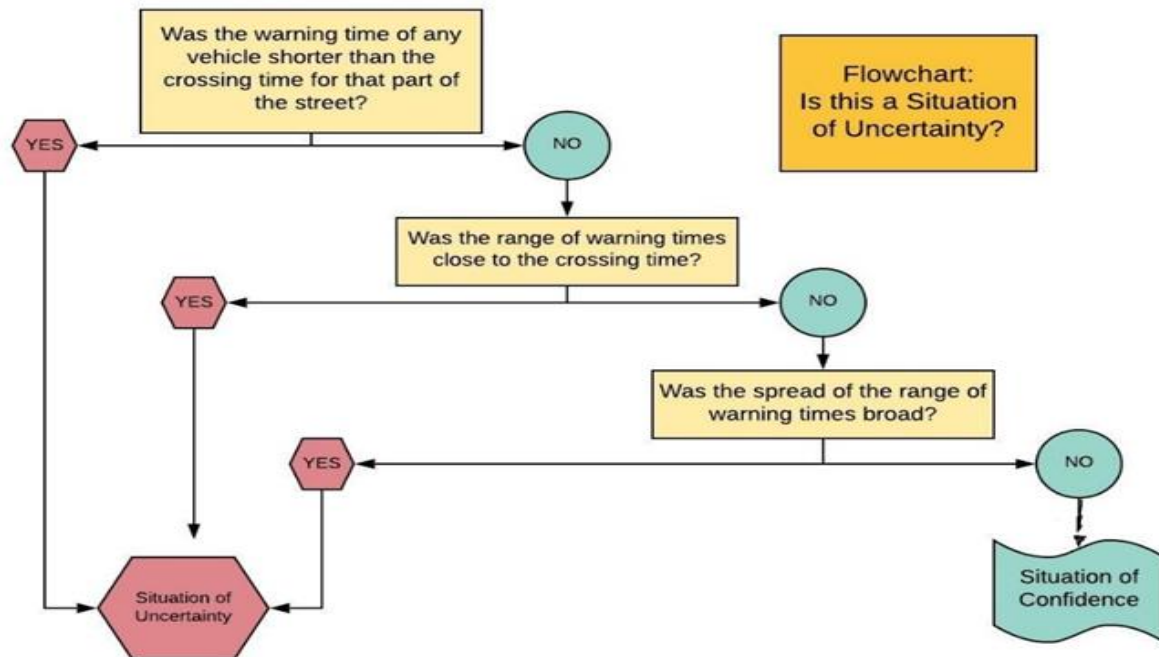


Figure 1: Flowchart: Is this a Situation of Uncertainty?

Fourth step: Repeat this procedure at a variety of uncontrolled crossing situations until students can consistently draw accurate conclusions and determine if they are in a Situation of Uncertainty or Confidence.

This phase of training involves taking students to a variety of crossing situations and asking them to listen (or watch) for approaching vehicles and judge whether it is a Situation of Uncertainty or a Situation of Confidence, based on whether the warning times of approaching vehicles from both directions are longer than their crossing time. This is best done at crossings where there is intermittent traffic, such

that there are plenty of times when it is quiet, and plenty of times when a vehicle is approaching.

Students using their vision will assess the situation in each direction separately. That is, they analyze their detection of vehicles in one direction until that assessment is complete, then they turn and do the same for traffic coming from the other direction. It is essential that they develop strategies to look from one side to the other efficiently to make sure it is clear in both directions (Fazzi and Barlow, 2018, Barlow, Bentzen, Sauerburger and Franck 2010) - these strategies are explained by Sauerburger and Bourquin (2020) and should be addressed after the students have learned to

assess whether there is a Situation of Uncertainty in either direction, assessing one direction at a time.

Assessing Risk of crossing in Situations of Uncertainty

When students find themselves in a Situation of Uncertainty, their first step is to assess the risk of crossing. If they cross in these situations, they will be crossing when there may be approaching vehicles that would have to slow down or even stop to avoid hitting them, so to assess the risk of crossing they need to find out:

- 1) whether they have the right of way there,
- 2) how likely they will be surprised by an undetected vehicle that could reach them during their crossing and if that happens,
- 3) how likely it will hit them, and
- 4) if they are hit, how likely they would be seriously injured or killed.

Students should be familiar with the pedestrian laws in their community to know whether they are risking being hit by a driver who has the right of way. The likelihood that they would be surprised by an undetected approaching vehicle depends on traffic volume and how well they can detect the approaching vehicles. If there is very little traffic, and they can hear the approaching vehicles with almost enough warning then it will be much less likely there is an undetected vehicle that could reach them during their crossing than if there are lots of vehicles there, and they cannot be heard until just before they reach the crossing.

There are several factors to consider when determining the chances of a vehicle hitting them if it approaches unexpectedly during their crossing. If the visibility and road conditions are good, they are using a cane, and drivers are going slowly and expecting pedestrians, then the likelihood that they would be hit is less than if the roads are slippery and it is difficult for drivers to see them, they are not using a cane and are crossing where pedestrians are not expected, and the traffic is traveling fast. In addition, if there is more than one lane for approaching vehicles in either direction, there is the possibility of “multiple-threat collision,” where one vehicle stops for a pedestrian and drivers in other

lanes cannot see the pedestrian until it is too late for them to stop.

If pedestrians are hit, the likelihood that they would be seriously injured or killed would depend on the speed of the vehicle. For example, there is about a 20% chance of being seriously injured or killed if hit by a vehicle going less than 32 kilometers/20 miles per hour, and this likelihood increases to 70% if the vehicle is going faster than 73 kilometers/ 46 miles per hour (NHTSA 1999).

Our students should be able to take all these factors into consideration and determine how likely it is that if they cross in that situation with those conditions, they will be surprised, hit, and seriously injured by a vehicle that was undetected when they began their crossing. If the risk of this happening is not acceptable, they need to be able to implement alternatives to crossing in this situation, such as getting assistance, crossing somewhere else, avoiding the crossing altogether by getting a ride or choosing not to go to that destination at that time, etc. Different students will have different levels of acceptable risk, this process of analysis is designed to help them determine what they are comfortable with in a systematic way that encourages conscious decision-making based on objective observations of the key factors.

Examples

The following examples were written by an instructor teaching two adults about uncontrolled crossings, one of whom was at a Situation of Uncertainty, and one at a Situation of Confidence:

Example 1: Recognizing a Situation of Uncertainty, and analyzing the risks

The student was at a residential intersection of two streets that had stop signs for one of the streets, but not the other. She had just learned how to cross the street with the stop sign, and we now turned and talked about how to cross the other street. She said she'd want to cross it when no traffic is coming, and she learned that she could be confident that no traffic is coming whenever it is quiet only if she has

enough warning of approaching vehicles, so we started to analyze whether or not she had enough warning of the vehicles in that situation.

First, we timed her crossing. I asked her to cross the street several times when I said it was clear; her first crossing took 10 seconds and the second took 13, so her crossing time was 13 seconds. After she spent about 5 minutes developing an accurate intuitive understanding of her crossing time, I asked her to wait till it was quiet, then report when she heard something that might be a vehicle approaching.

However, when she said it was quiet, I could still hear receding car sounds, and then she said she thought she heard a car. Three seconds later the car arrived, and she correctly guessed that it wasn't enough warning time for that car. I helped her understand that she didn't know whether she would have heard it with enough warning if it had been quiet when she had heard it. So, we waited until we agreed it was quiet, and then listened again for approaching vehicles.

When she reported she thought she heard something that might be a car, I started the timer, and stopped it when the vehicle passed our crosswalk. Without telling her that it was 7 seconds, I asked her if there was enough warning of that vehicle's approach. She correctly said no. Then I asked her how far she would have gotten by the time it arrived if she had started just before she heard it (while it was still quiet). Again, she was correct when she said she'd be about halfway across.

At that point, we could conclude that in that situation, she could not be confident that it was clear to cross whenever it was quiet - she was in a Situation of Uncertainty. We then used the checklist "Risk Analysis for Situations of Uncertainty" to determine how likely it would be that a vehicle would be coming when she started to cross and if that happened, how likely she'd be hit and seriously injured or killed.

Evaluating the items on the checklist, we decided that whenever it was quiet

(1) it was moderately likely that there would be a vehicle approaching because traffic volume was moderate, and she was unable to hear some of them till they were fairly close;

(2) if an undetected vehicle was approaching as she started to cross, it was moderately likely that it would hit her because, even though road conditions were good and drivers might expect pedestrians there and she would be using a white cane, it was difficult for drivers to see her and they were going moderately fast;

(3) if the vehicle did hit her, there was a 42% chance of being seriously injured or killed (traffic was going at about 30-50 kmh / 25-30 mph).

She decided that the risk was not acceptable, and we considered alternatives.

Example 2: Recognizing a Situation of Confidence, and the effect of masking sound

The lesson took place at a residential intersection with no stop sign for the street we were analyzing. We had determined that his crossing time was 7 seconds and he had developed an intuitive understanding of that crossing time. We began to analyze the situation to determine whether there was enough warning from approaching vehicles for him to be confident that it's clear to cross when quiet.

Like the first student, he reported hearing a car when it was not quiet, and correctly guessed that it did not give enough warning. I then asked him if it was quiet when he heard it, and after thinking for a while, he said there were sounds of receding cars. I explained that the sound of receding cars can significantly mask the sound of approaching vehicles, so we did not know yet whether or not he could hear them with enough warning when it's quiet. So, he waited till it was quiet, and then

reported when he thought he heard something that might be another vehicle, and I started the timer.

I stopped the timer when the car passed us and, without telling him that it was 15 seconds before the car arrived, asked if it was enough warning. He said it was, and I told him it was 15 seconds - we laughed, saying he'd have enough time to cross and come back and have a cup of coffee. As we talked, another car approached but we didn't hear it until it was just a few seconds away, and I asked why we could hear the other car so far away but not this one. He said the car we had timed was still receding, and masked the sound of the other car.

We started listening again and I asked several times if it was quiet yet. He kept saying no, and just as I heard the last sound die away, he said it just became quiet. Throughout the lesson, I kept asking whether it was quiet until I became convinced that he could recognize masking sounds and know when it is actually quiet.

Once, when we listened while quiet, he reported hearing something that might be a car, and I started the timer and thanked him, saying I was so glad he was not waiting to be sure it's a car before reporting that he heard it. It turned out not to be an approaching vehicle so I reset the timer and thanked him again and he resumed listening.

The warning times for the next few vehicles heard from the left when quiet were 21 and 22 seconds, and another from the right was heard 22 seconds away, I asked him if he felt that was enough samples to feel confident he has enough warning. He said yes, although he said the situation could be changed with environmental noises, and I agreed, adding that even the ambient sound level of "quiet" can change dramatically during the day. So we affirmed that his conclusion only applies to this moment in time.

I then asked him why he could feel so confident that it would be clear to cross whenever it was quiet, given that we only had a few samples of vehicles approaching when quiet. After some prompting, he explained that it was because the warning times

were all more than twice as long as he needed, and the range of samples was relatively narrow, so it seemed extremely unlikely that whenever it was quiet, a vehicle could get too close without his being able to hear it.

Summary

The goal of this training is for travelers with visual impairments to demonstrate that they can correctly determine if they can be confident that it's clear to cross when quiet when presented with a variety of crossing situations that include at least one Situation of Confidence and one Situation of Uncertainty; analyze the risks of crossing in each Situation of Uncertainty; and implement alternatives if the risk is not acceptable. As with any O&M skill, students should practice this method repeatedly with supervision in a variety of situations and environments before they can be deemed to be using the methods effectively and proceed to independent use when traveling alone.

Further details, checklists, considerations, and suggestions about this process with illustrations and videos are in the "Self-Study Guide: Preparing Visually Impaired Students for Uncontrolled Crossings" at www.sauerburger.org/crosscredit. Another resource is the software program "Crossings with no Traffic Control: Teaching Concepts and Skills to Deal with Them," developed by Dona Sauerburger with the American Printing House for the Blind (www.aph.org). It provides simulation experiences and information to help O&M instructors teach these skills.

Conflict of Interest: The authors have no conflicts of interest to disclose.

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