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Visibility: Regulations, Context and Community

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Introduction

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Signs are and continue to be important navigational tools that help passersby orient themselves to urban landscapes. These devices become part of these urban environments and are utilized by a wide variety of pedestrians and motorists. Those who erect these signs do so with the hope that their messages will be seen and understood by all who view them. The same is true for those who generate public art displays, which are typically regulated in similar fashion to signs. Localities are committed to regulating signs to ensure that they do not cause safety issues or create aesthetic blight. Crafting regulations that weigh the need to be viewed with issues of public safety is a fine balancing act. The authors contained in this issue of the Interdisciplinary Journal of Signage and Wayfinding seek to share the importance of context and cognition as a basis for establishing regulations that may affect the visibility of both signs and public art.

Garvey and Klena challenge readers to consider the impact of minimum and maximum sign height requirements on visibility. Communities consistently establish maximum sign heights to maintain aesthetic consistency. The authors suggest, based on empirical research, a minimum sign height should be established to ensure that signs are not obscured by other obstacles. They provide a list of urban characteristics they believe can help policymakers make evidence-based decisions to ensure that signs are appropriately designed based on relevant environmental characteristics. This study extends upon the developing understanding of the importance of context in regulating sign characteristics, building on the assumption that signs should be placed in locations and ways that they are visible to a wide audience.

Sundar, Wu, and Kardes are similarly interested in the topic of sign visibility. Their study focuses on the impact of faded fonts on visibility and information retention. The authors hypothesize that faded fonts may, in fact, increase viewer awareness. To test this hypothesis, the team ran two experiments with faded fonts on images comprised of both greyscale and high-contrast black and white text. In each experiment, the researchers concluded that faded fonts can, in fact, increase awareness because viewers take more time to process the information available to them. The team plans to expand upon this work in the future to better understand how the use of faded fonts might influence short- and long-term memory, as well as how movement affects the processing of such information.

Greub reflects on the power of public art as a medium for communication in a pedestrian-oriented public space. As part of a design competition, she and her team composed an urban design plan for Blocks 69-70 in the Central Business District of Salt Lake City, UT. One element she proposes is the use of media screens that the public may utilize to publicly display private images through social media. Her team's design also emphasizes a variety of multifunctional spaces intended to enhance community through artistic flexibility and public art.

Each article contained in this issue fills important gaps in our knowledge about visibility. As a collective, these authors provide us with a more solid base for understanding the importance of visibility of signs by all users.

Recommended Mounting Heights for Freestanding On-Premise Signs

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BACKGROUND AND OBJECTIVES

Freestanding on-premise signs are commercial signs that are not attached to buildings or other structures and include ground-mounted, monument, pylon, and pole signs. This report focuses on issues related to the appropriate mounting height of freestanding signs.

On-premise sign mounting height is generally controlled by local governments using content-neutral time, place, and manner regulations. In the absence of solid data on appropriate mounting height from the perspectives of sign visibility and driver safety, this sign characteristic is being regulated from the standpoint of aesthetics (Jourdan, Hurd, Hawkins, & Winson-Geideman, 2013). For example, Agoura Hills, CA (n.d.) has set a maximum height of 6 feet to the top of monument signs in part to "preserve and enhance the unique character and visual appearance of the city" (p. 2), and in 2018, Dutchess County, NY recommended a maximum height of 4 to 7 feet to the top of some freestanding signs, stating that the signs could then be "better integrated with landscaping" and "less likely to obstruct views of neighboring properties or the sky" (p. 2). There are indeed countless examples of regulatory entities enacting restrictions on sign height, typically focused on a maximum sign height of 6 feet. This trend runs counter to research that has long shown that low sign mounting heights restrict motorists' ability to find and read signs [Manual on Uniform Traffic Control Devices (MUTCD), 1935; Pietrucha, Donnell, Lertworawanich, & Elefteriadou, 2002] and therefore have a negative impact on traffic safety (Kuhn, Garvey, & Pietrucha, 1997). The consensus of regulators seems to be that lower signs are better, with a *de facto* standard maximum height of 6 feet to the top of the sign in some zones and/or for certain sign users.

The objective of this report is to develop best practices for optimal freestanding on-premise sign mounting height based on roadway factors, sign visibility, and traffic safety, relying on existing research and practice and basic geometry, and describing variations for different road types and sign lateral offsets.

To achieve this, the existing on-premise and traffic sign mounting height research was reviewed, and the current state-of-the-practice was summarized. In addition, a technical analysis of on-premise sign height and sign visibility based on roadway cross-section and driver-to-sign sightlines was conducted.

SIGN MOUNTING HEIGHT DEFINED

Traffic Signs (e.g., Stop Signs, Street Name Signs, Construction Signs)
The federal MUTCD (2009) sets the minimum allowable sign height for traffic and regulatory signs in commercial areas at 7 feet "measured vertically from the bottom of the sign to the top of the curb" (p. 42), or if there is no curb, to the edge of the road (Figure 1). The purpose of this minimum height is to keep pedestrians from hitting their heads on the signs and to reduce the likelihood that views of the signs will be blocked by parked or moving traffic. A minimum height of 5 feet is required for rural signs. There are no set limits on maximum mounting height.

On-Premise Signs
Contrary to regulations for traffic signs, on-premise sign mounting height is controlled by local and county ordinances that limit the maximum height from the road surface to the top of the sign (Figure 2). The purpose of these restrictions is typically stated as follows: "to encourage the effective use of signs as a means of communication in the City; to maintain and enhance the aesthetic environment and the City's ability to attract sources of economic development and growth; to improve pedestrian and traffic safety; to minimize the possible adverse effect of signs on nearby public and private property; and to enable the fair and consistent enforcement of

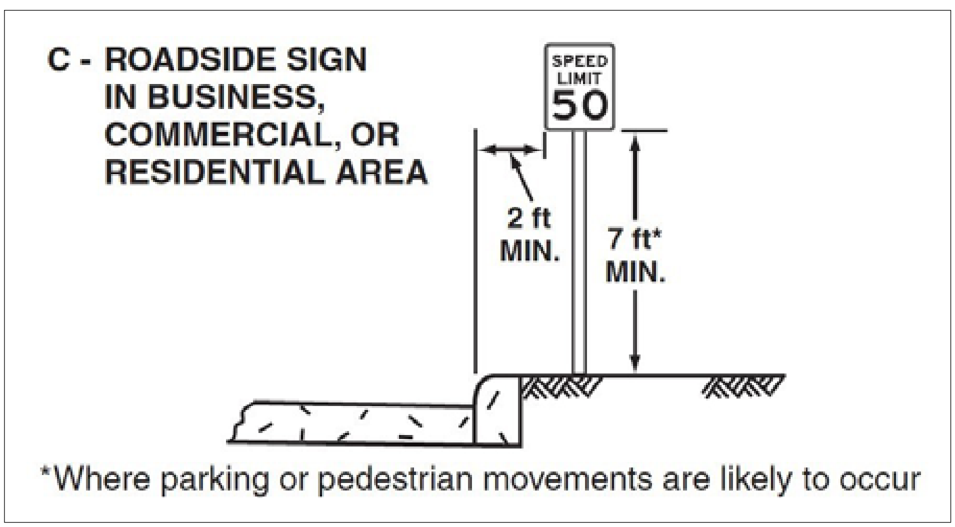

Figure 1 / Traffic sign mounting height (MUTCD, 2009).

these sign regulations" (Ashland, NE, 2006, p. 7-1). It should be noted that there no city or county set limits on minimum mounting height for on-premise freestanding signs.

RESEARCH LITERATURE

Traffic Signs

There has been very little research on appropriate mounting heights for either on-premise or traffic signs. When asked if there was any research basis for the requirement of 5- and 7-feet minimum mounting heights for traffic signs discussed above, the Federal Highway Administration's (FHWA) MUTCD Team stated that their minimum mounting heights date back to the earliest edition of the MUTCD (1935), and have been in every subsequent edition. The 7-feet requirement is for areas where parking, other obstructions, and pedestrians and bicyclists are found. Typically in urban, business, commercial, or residential areas, the 7-feet height protects pedestrians and bicyclists from head injuries and provides adequate sign visibility given the higher presence of vehicles and equipment that can obstruct views of the signs. In rural areas, where these types of obstructions and concerns are less common, a shorter 5-feet minimum is allowed. The 5-feet minimum affords visibility around obstacles such as snow banks, snow drifts, and vegetation commonly found along rural roads. In summary, the FHWA stated that it is unaware of any specific research that supports the sign height requirements. However, they did say that these minimums have generally proven to be adequate and are readily accepted by the engineering community (FHWA, personal communication, September 4, 2018).

On-Premise Signs

A model sign code was developed by Urban Design Associates under contract to the International Sign Association (ISA) in an attempt to provide sign regulation based on research, rather than by committee (Jourdan, Hawkins, Abrams, & Winson-Geideman, n.d.; Jourdan et al., 2013). These authors developed a formula for maximum sign height that would allow the entire sign to be in the driver's useful visual field. A key element in their calculations was sign letter height. For example, signs with 5-inch letter heights would have a maximum mounting height of 16.6 feet (see Figure 3 for more examples).

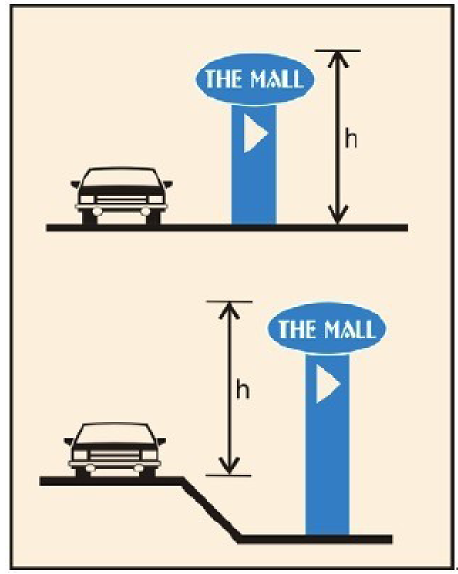

Figure 2 / On-premise sign mounting height (Bertucci & Crawford, 2011).

Letter Height, inches	5	10	15	20	25	30
Maximum Sign Height, ft	16.6	29.7	42.9	56.0	69.1	82.2

Figure 3 / Maximum sign height to top of sign (Jourdan et al., n.d.).

Specifying appropriate sign height as a function of drivers' lines of sight and visual fields, as Jourdan et al. (n.d.) did in Figure 3, has been discussed since the 1950s (see Garvey & Kuhn, 2011, for a review). The research-based United States Sign Council Foundation Model Sign Code took a different approach; the primary goal of these standards was to "insure that all on-premise signs have sufficient area and mounting height to provide a motorist with adequate time and travel distance to detect a sign, read and understand its contents, and then execute an appropriate driving maneuver" (Bertucci & Crawford, 2011, p. 39) These authors recommended maximum free standing sign heights of 8 feet in residential zones, 12 feet in office and professional zones, and anywhere from 14 to 86 feet (depending on zoning district and speed limit) in commercial and industrial areas.

Finally, the research that most directly pertains to the present paper was conducted by Pietrucha et al. (2002). These researchers determined the probability of another vehicle blocking the line of sight between a driver and a low-mounted on-premise freestanding sign. They looked at 10-feet wide signs with maximum mounting heights of 5 feet measured from the grade level to the top of the sign. Consistent with commercial areas where many on-premise signs are found, the researchers analyzed four-lane undivided roadways with 35- and 45-mile-per-hour speed limits. These researchers found that depending on the rate of traffic, the signs were blocked anywhere from 11 to 90 percent of the time. While they did not provide a recommendation for a minimum sign mounting height that would alleviate this problem, Pietrucha et al. (2002) concluded, "the most direct solution [to reduce sign blockage] is to elevate the sign to the point where copy presentation is above the blocking aspect caused by other vehicles on the road" (p. 26). The remainder of this report details an effort on the part of the present authors to do this.

TECHNICAL ANALYSIS: CALCULATING THE MINIMUM ON-PREMISE FREESTANDING SIGN MOUNTING HEIGHT NECESSARY TO AFFORD DRIVERS A CLEAR LINE OF SIGHT OVER OBSTRUCTING VEHICLES

Overview

To design any roadway feature, it is necessary to make assumptions and compromises. This is true for complex intersection design, roadway alignment, railroad crossings, and bridges; to design a minimum mounting height for freestanding on-premise signs that will ensure they are not blocked by other vehicles is no exception. As with the development of any roadway design, the goal here is not to accommodate every possible scenario, as that would be impossible, or at a minimum impractical, but rather to establish a mounting height at which most drivers will have an unobstructed view of most signs, most of the time.

Design Vehicles

To accomplish this, one must first decide what to use as the design vehicle. That is, what kind of vehicle is the driver who is looking for the sign driving (the observation vehicle) and what kind of vehicle is potentially blocking the sign (the blocking vehicle). The conservative (with regard to sign visibility) choice for the observation vehicle is a "passenger vehicle," which would include "passenger cars of all sizes, sport/utility vehicles, minivans, vans, and pick-up trucks" [American Association of State Highway and Transportation Officials (AASHTO), 2011, p. 2-1]. This is conservative because the eyes of a passenger vehicle driver are low to the ground compared to those of a heavy truck or bus driver—two other possible design observation vehicles. To design a minimum sign mounting height that would accommodate truck or bus drivers would result in signs that are too low for drivers of passenger vehicles to see (Layton & Dixon, 2012). With regard to the blocking vehicle, while trucks and buses have a higher profile and are therefore more likely to block on-premise signs, passenger vehicles make up the preponderance of vehicles on the roadway and have the greatest probability of coming between an observer and an on-premise sign.

Driver Eye Height and Blocking Vehicle Height

The next thing to do is determine what height to use for the driver of the observation vehicle's eyes and what height to use for the blocking vehicle. To that end, the AASHTO (2011) established a standard of 3.5 feet for driver eye height in passenger vehicles and 4.25 feet as the height of a standard passenger vehicle. While it is obvious that driver eye height and vehicle height can vary greatly across the driver and vehicle population (as there are tall and short drivers, drivers with good or slouchy posture, and larger and smaller vehicles), these heights were selected through research to accommodate the majority of U.S. passenger vehicles and drivers. These numbers are used by engineers in roadway and intersection design and have also been adopted by the FHWA for the size and placement of traffic signs for no-passing zones (MUTCD, 2009). However, due to trends in U.S. vehicle design and consumer preferences, it is possible that these numbers are outdated; this will be discussed further below.

Method

Mathematical. To determine whether an observer has a clear line of sight from their vehicle to an on-premise sign, it is necessary to know the height of the observers' eyes and the height of the blocking vehicle (these will be constants in our equation), the distance between the observer and the blocking vehicle (this will be a variable), and the distance between the observer and the target sign (this will also be a variable). These four data points allow one to calculate the slope of a line with the origin at the observer's eye, passing over the top of a blocking vehicle, and ending on the bottom of the sign copy (Figure 4). A clear line of sight to the bottom of the sign copy will allow the observer to read the entire sign.
The distance between the observers' eyes and the blocking vehicle and the distance between the observers' eyes and the sign are a function of the roadway cross section, the side of the road the sign is on, and the lateral offset of the sign from the roadway. Roadway cross section is the number of lanes, the lane width, and the presence or absence of parking lanes and their widths.

While the possible configurations are virtually limitless, for the purposes of explication in this report, the line of sight and the resulting minimum on-premise sign mounting heights from the road surface to the bottom of the sign was calculated for four common roadway configurations:

1. one-way, one lane;
2. one-way, two lane;
3. two-way, two lane; and
4. two-way, four lane.

For this exercise, all travel lanes were assumed to be 10-feet wide (NACTO, 2013a). The one-way roads had two 8-feet wide parking lanes (NACTO, 2013a), one along each side of the roadway; the two-way roads had no parking lanes, but they did have 2-feet wide shoulders along both sides

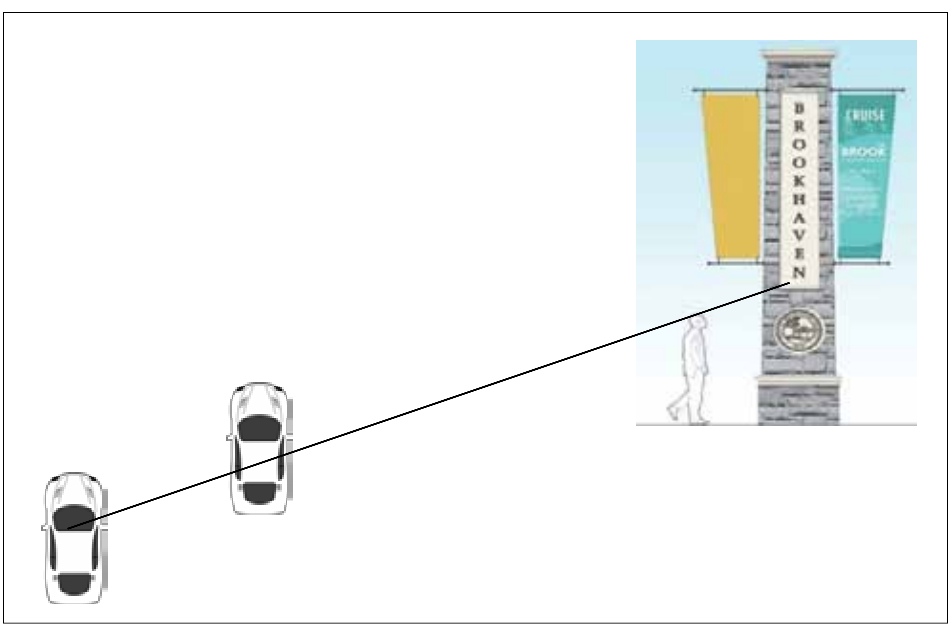

Figure 4 / Line of sight from observer driver's eyes over blocking vehicle to the bottom of the sign copy.

of the roadways. The passenger vehicles were set at a width of 6.5 feet (NACTO, 2013b). They were assumed to be driven in the center of the travel lanes, the drivers' eyes were assumed to be in the middle of the left half of the vehicle, and the cars parked in the parking lane were assumed to be located one foot from the travel lane. See Figure 5 for illustrated representations.

Appendix A contains a detailed explanation of a geometric equation that can be used to determine the minimum recommended sign mounting height for any on-premise freestanding sign. The example employs AASHTO's recommendations for design driver eye height and vehicle height. The math uses the slope of the line of sight from an observer's eyes just over the top of a blocking vehicle.

With this technique, minimum sign mounting heights were established for each of the four scenarios listed above, for all travel lanes, with signs on both the left and right sides of the roadway, at sign offsets from the

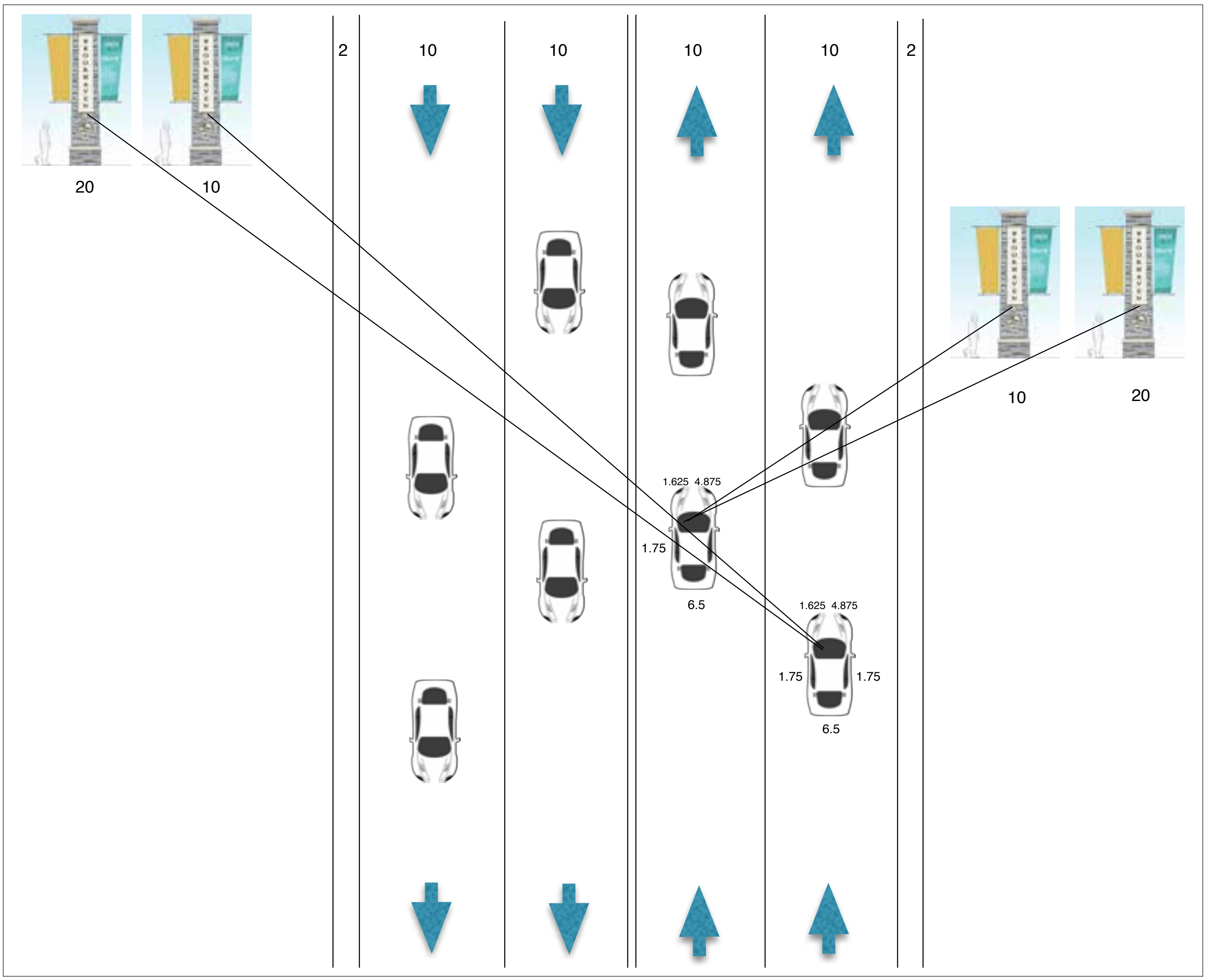

Figure 5 / Illustrated example of roadway conditions.

roadway edge of 10 and 20 feet, the same offsets used by Pietrucha et al., 2002. The results are shown in Appendix B.

Field Validation. While mathematical calculations are extremely useful in establishing minimum sign mounting height, and can be applied to any roadway cross section and sign lateral offset, it is important to field-validate the results to ensure their accuracy. Using AASHTO's vehicle and driver eye heights, the National Association of City Transportation Officials (NACTO, 2013c) published a simple procedure to "determine whether an object is a sight obstruction" (p. 4.3. While NACTO was interested in evaluating intersection sight distance, with slight modifications their methods were used here to field-validate the mounting heights established mathematically for on-premise signs. This would, as Pietrucha et al. (2002) said, ensure that the signs are elevated "to the point where copy presentation is above the blocking aspect caused by other vehicles on the road" (p. 26)

NACTO's procedure involved constructing a black sighting device (3.5-feet high) to mimic the point of view of a driver and an orange sighting device (4.25-feet high) to mimic a blocking vehicle (Figure 6).

Figure 6 / Data collection apparatus and setup.

When placed in alignment with a proposed on-premise sign at the desired distance, the experimenter can determine at what height the sign needs to be for the entire message to "clear" the obstructing vehicle. This is done by visually lining up the horizontal black bar (driver eye height) with the horizontal orange bar (blocking vehicle), having another experimenter standing on a ladder at the distance of the proposed sign, and extending a measuring tape up into the air until it just clears the lined-up horizontal bars.

The results are displayed in blue highlight at the bottom of the table in Appendix B. The findings show equivalence between the mathematical model and the field measurements. Most of the field measurements were within one inch of the mathematical model, with the smallest difference being 0.01 feet and the largest being 0.21 feet. Using the mathematical model, the average minimum mounting height for signs with an offset of 10 feet was 7.48 feet (sd = 1.43), and the average for the field validation was 7.52 feet (sd = 1.34). Using the mathematical model, the average minimum mounting height for signs with an offset of 20 feet was 8.78 feet (sd = 1.64), and the average for the field validation was 8.75 feet (sd = 1.52). Independent samples t-tests were conducted to compare the results of the mathematical model and the field measurements. These analyses revealed no statistically significant differences between the computed and the measured data (t = -0.06, p = 0.48 and t = 0.03, p = 0.49, respectively for the 10- and 20-feet offsets), thus field-validating the results of the geometric calculations.

Driver Eye Height and Blocking Vehicle Height Revisited

AASHTO's driver eye height of 3.5 feet and blocking vehicle height of 4.25 feet discussed above and used in the calculations for the current research are well established, accepted, and respected in the transportation field. Upon close inspection, however, it becomes clear that these numbers cannot be taken at face value for the purposes of establishing on-premise freestanding sign mounting heights. There are two reasons for this.

First, Fambro, Fitzpatrick, & Koppa, 1997 (the research used by AASHTO to determine design height) found that more than 97 percent of passenger vehicles on U.S. roadways in 1993 had higher driver eye height than the 3.5 feet recommended by AASHTO, and 90 percent of passenger vehicles were taller than AASHTO's design height of 4.25 feet. Using these low numbers makes sense for AASHTO, as it enabled the organization to conservatively design intersection sight distances and stopping sight distances, but to achieve the objective of the present study (i.e., to establish a minimum mounting height at which most drivers will have an unobstructed view of most signs, most of the time), it makes more sense to use a driver eye height and passenger vehicle height that is more representative of actual driving conditions. To do this, the 15th percentile driver eye height and 85th percentile vehicle height were chosen. This accounts for driver eye height in smaller cars and smaller multipurpose vehicles when they encounter the blocking height of larger cars and larger multipurpose vehicles. These percentiles accommodate 70 percent of driving scenarios, with only the smallest observation vehicles and largest blocking vehicles not being accounted for.

Second, the research AASHTO used to derive their numbers drew data from the population of passenger vehicles that were on United States roads in 1993. This would not be a problem if vehicle type and dimensions had remained stable over the past quarter century. However, this has not been the case. There is clear evidence that personal vehicle size has been steadily rising, a result of the well-documented increase in popularity of SUVs and pickup-trucks, and systemic changes to both car and SUV dimensions. Unfortunately, there is no report like Fambro's that has established current dimensions for personal vehicle height or measurements of driver eye height.

The National Cooperative Highway Research Program has proposed new research on this issue for 2020, and that proposal is under review. If changes are recommended from that research, AASHTO would "most likely" include them in a future edition of the Green Book (AASHTO, personal communication, November 5 and 7, 2018). However, as establishing an appropriate on-premise sign minimum mounting height is a critical, time-sensitive issue, waiting until the mid-2020s for a possible update of AASHTO's numbers is unfavorable. In the absence of more current research , the findings from Fambro et al. (1997) were mathematically "updated" for use in this report, via a two-step process.

First, as Fambro et al. (1997) reported data separately for cars and multipurpose vehicles, it was necessary to combine those numbers into a single eye height and vehicle height for all 1993 passenger vehicles. To do this, the data were weighted by vehicle type. In 1993, cars accounted for 66.3 percent of personal vehicles, and the combination of SUVs, vans, and pick-up trucks (aka, multipurpose vehicles) only accounted for 33.7 percent (Fambro et al., 1997). The 15th percentile car and multipurpose vehicle eye heights and the 85th percentile car and multipurpose vehicle heights were combined as shown below:

U.S. PASSENGER VEHICLE DISTRIBUTION: 1993

Passenger Cars = 66.3 percent
Multipurpose Vehicles = 33.7 percent

15th percentile passenger car driver eye height = 3.59 ft x 0.663 = 2.38
15th percentile multipurpose vehicle driver eye height = 4.37 ft x 0.337 = 1.47
15th percentile driver eye height = 3.85 ft

85th percentile passenger car height = 4.67 ft x 0.663 = 3.10
85th percentile multipurpose vehicle height = 6.3 ft x 0.337 = 2.12
85th percentile blocking vehicle height = 5.22 ft

The second step was to take those 1993 numbers and update them using the current distribution of vehicle types on the U.S. roadways. FHWA's National Household Travel Survey revealed that in 2017, 52.05 percent of U.S.-registered personal vehicles were cars, and 47.95 percent were multipurpose vehicles. The above 1993 numbers were weighted by vehicle type to establish a single 15th and 85th percentile for all 2017 passenger vehicles combined using the following calculations, with the following results:

U.S. PASSENGER VEHICLE DISTRIBUTION: 2017

Passenger Cars = 52.05 percent
Multipurpose Vehicles = 47.95 percent

15th percentile passenger car driver eye height = 3.59 ft x 0.5205 = 1.87
15th percentile multipurpose vehicle driver eye height = 4.37 ft x 0.4795 = 2.09
15th percentile driver eye height = 3.96 ft

85th percentile passenger car height = 4.67 ft x 0.5205 = 2.43
85th percentile multipurpose vehicle height = 6.3 ft x 0.4795 = 3.02
85th percentile blocking vehicle height = 5.45 ft

These results were then rounded to the following estimate of the 2017 U.S. vehicle population to be used in establishing minimum on-premise freestanding sign mounting heights:

Driver Eye Height = 4.0 ft
Blocking Vehicle Height = 5.5 ft

These numbers were inserted into the formula discussed earlier and listed in Appendix A, replacing the 3.5 feet and 4.25 feet heights. The updated 2017 calculation is shown in Appendix C. The results are included in red at the bottom of the table in Appendix B.

RESULTS AND CONCLUSIONS

The ultimate objective of this research project was to establish evidence-based optimal freestanding on-premise sign mounting heights from a sign visibility and traffic safety perspective. The evidence used was a review of the literature and current practices and new design research conducted specifically for this report.

When past research on traffic and on-premise sign mounting heights was evaluated, one key finding was that there was a philosophical difference in the very definition of sign mounting height. Traffic signs have a mandatory *minimum mounting height* from the road to the *bottom* of the sign, while on-premise signs typically have a mandatory *maximum mounting height* from the road to the *top* of the sign. Traffic sign mounting height definition is based on sign readability and safety, while on-premise sign mounting height is defined in such a way as to make the signs more aesthetically pleasing (i.e., to be less "obtrusive"). While no one would try to argue for less attractive on-premise signs, their primary purpose is to be seen and read in a timely fashion by the motoring public. For this to occur, the signs must be mounted high enough to avoid being blocked by other vehicles on the roadway.

The design research conducted especially for this report yields specific sign height minimums as a function of roadway cross section, the side of the road on which the sign is mounted, and the sign's lateral offset. It is recommended that the sign height calculator (developed using the results of this research and the calculations detailed in Appendix C) be used to determine the *minimum mounting height* of on-premise freestanding signs. The calculator (available online at https://www.garveyandassociates.com/calculator) will provide the user with the minimum sign mounting height when they answer the following nine questions:

1. What side of the road is the sign is on?
2. Is the road one-way or two-way?
3. How many lanes of traffic are there?
4. How wide are the lanes?
5. What is the width of the median or turning lane? (Enter "0" if there is no median or turning lane.)
6. What is the width of the shoulder? (Enter "0" if there is no shoulder.)
7. What is the width of the bike lane? (Enter "0" if there is no bike lane.)
8. What is the width of the parking lane? (Enter "0" if there is no parking lane.)
9. What is the sign offset from the traveled way?

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APPENDIX A

This Appendix provides a detailed example of the mathematical procedure used to determine the minimum freestanding on-premise sign mounting height necessary to avoid blockage by other vehicles.

For this exercise, AASHTO's (2011) 3.5-feet driver eye height and 4.25-feet personal vehicle height were used, and the travel lane was 10-feet wide, with two 8-feet wide parking lanes, one along each side of the roadway. All vehicles were set at a width of 6.5 feet. They were driven in the center of the travel lanes, the drivers' eyes were in the middle of the left half of the vehicles, and the cars parked in the parking lanes were located one foot from the travel lane. The sign had a 10-feet offset from the traveled way and was located on the right side of the road (see Figure 1, page 4, for an illustration).

STEP ONE

Solve for m, where m is the slope of a line from the driver's eye to just over a blocking vehicle.

$m = y_2 - y_1/x_22 - x_1$

And where: $x_1 = 0$ and $y_1 = 3.5$
[x_1 is the observer location and is a constant, y_1 is the observer eye height and is a constant.]

And where: $x_2 = d$ and $y_2 = 4.25$
[x_2 is the lateral distance between the driver of the observation vehicle and the nearest blocking vehicle and is a variable; y_2 is the height of the blocking vehicle and is a constant.]

Plug in a value for x_2 and solve for m (in this example, $x_2 = 7.625$):

$m = 4.25 - 3.5/7.625 - 0$

$m = 0.75/7.625$

$m = 0.09836$

STEP TWO

Solve the line equation for a missing coordinate (i.e., y_2, which is the minimum sign mounting height) again using the equation:

$m = y_2 - y_1/x_2 - x_1$

To do this, first insert the numbers for m, y_1, and x_{1x} from above:
$0.09836 = (y_2 - 3.5)/(x_2 - 0)$

x_2 is the lateral distance between the driver of the observation vehicle and the proposed sign location. In this example $x_2 = 24.625$.

Insert the value for x_2 into the equation and solve for y_2:

$0.09836 = (y_2 - 3.5)/(24.625 - 0)$

$0.09836 = (y_2 - 3.5)/24.625$

$2.422115 = y_2 - 3.5$

$y_2 = 5.922$ — This is the minimum required mounting height for this example.

APPENDIX B

Method of Determining Minimum Mounting Height		10-ft wide travel lanes									
		Parking Lanes (8-ft wide)									
		One lane, one way				Two lanes, one way					
		Sign on Right		Sign on Left		Sign on Right			Sign on Left		
						Driver in Right Lane	Driver in Left Lane		Driver in Right Lane		Driver in Left Lane
	Sign Lateral Offset (ft)	Distance from driver eye to blocking car (ft)	Distance from driver eye to sign (ft)	Distance from driver eye to blocking car (ft)	Distance from driver eye to sign (ft)	Same as one lane	Distance from driver eye to blocking car (ft)	Distance from driver eye to sign (ft)	Distance from driver eye to blocking car (ft)	Distance from driver eye to sign (ft)	Same as one lane
	10	7.625	24.625	4.375	21.375		8.375	34.625	5.125	31.375	
	20		34.625		31.375			44.625		41.375	
		Slope	Minimum Mounting Height	Slope	Minimum Mounting Height		Slope	Minimum Mounting Height	Slope	Minimum Mounting Height	
Using AASHTO's Numbers	10	0.0984	5.92	0.1714	7.16		0.0896	6.60	0.1463	8.09	
	20		6.91		8.88			7.50		9.55	
Field Validation	10		6.00		7.17			6.75		8.08	
	20		7.00		8.75			7.58		9.42	
Using Updated Fambro Data	**10**	**0.1967**	**8.84**	**0.3429**	**11.33**		**0.1791**	**10.20**	**0.2927**	**13.18**	
	20		**10.81**		**14.76**			**11.99**		**16.11**	

Method of Determining Minimum Mounting Height		10-ft wide travel lanes								
		No Parking Lanes (2-ft shoulder)								
		Two lanes, two way (undivided)		Four lanes, two way (undivided)						
		Sign on Left		Sign on Right		Sign on Left				
				Driver in Left Lane		Driver in Right Lane		Driver in Left Lane		
	Sign Lateral Offset (ft)	Distance from driver eye to blocking car (ft)	Distance from driver eye to sign (ft)	Distance from driver eye to blocking car (ft)	Distance from driver eye to sign (ft)	Distance from driver eye to blocking car (ft)	Distance from driver eye to sign (ft)	Distance from driver eye to blocking car (ft)	Distance from driver eye to sign (ft)	
	10	5.125	25.375	8.375	28.625	5.125	45.375	5.125	35.375	
	20		35.375		38.625		55.375		45.375	
		Slope	Minimum Mounting Height	Slope	Minimum Mounting Height	Slope	Minimum Mounting Height	Slope	Minimum Mounting Height	Mean Minimum Mounting Height
Using AASHTO's Numbers	10	0.1463	7.21	0.0896	6.06	0.1463	10.14	0.1463	8.68	7.48
	20		8.68		6.96		11.60		10.14	8.78
Field Validation	10		7.25		6.25		10.00		8.67	7.52
	20		8.67		7.17		11.42		10.00	8.75
Using Updated Fambro Data	**10**	**0.2927**	**11.43**	**0.1791**	**9.13**	**0.2927**	**17.28**	**0.2927**	**14.35**	
	20		**14.35**		**10.92**		**20.21**		**17.28**	

This Appendix provides a detailed example of the mathematical procedure used to determine the minimum freestanding on-premise sign mounting height necessary to avoid blockage by other vehicles.

For this exercise, the 4.0-feet driver eye height and 5.5-feet personal vehicle height developed in this paper from Fambro, et al.'s (1997) data were used, the travel lane was 10-feet wide, with two 8-feet wide parking lanes, one along each side of the roadway. All vehicles were set at a width of 6.5 feet, they were driven in the center of the travel lanes, the drivers' eyes were in the middle of the left half of the vehicles, and the cars parked in the parking lanes were located one foot from the travel lane. The sign had a 10-feet offset from the traveled way and was located on the right side of the road (see Figure 5, page 8, for an illustration).

STEP ONE

Solve for m, where m is the slope of a line from the driver's eye to just over a blocking vehicle.

$m = y_2 - y_1/x_2 - x_1$

And where: $x_1 = 0$ and $y_1 = 4.0$
[x_1 is the observer location and is a constant, y_1 is the observer eye height and is a constant.]

And where: $x_2 = d$ and $y_2 = 5.5$
[x_2 is the lateral distance between the driver of the observation vehicle and the nearest blocking vehicle and is a variable; y_2 is the height of the blocking vehicle and is a constant.]

Plug in a value for x_2 and solve for m (in this example, $x_2 = 7.625$):

$m = 5.5 - 4.0/7.625 - 0$

$m = 1.5/7.625$

$m = 0.1967$

STEP TWO

Solve the line equation for a missing coordinate (i.e., y_2, which is the minimum sign mounting height) again using the equation:

$m = y_2 - y_1/x_2 - x_1$

To do this, first insert the numbers for m, y_1, and x_1 from above:
$0.1967 = (y_2 - 4.0)/(x_2 - 0)$

x_2 is the lateral distance between the driver of the observation vehicle and the proposed sign location. In this example $x_2 = 24.625$.

Insert the value for x_2 into the equation and solve for y_2:

$0.1967 = (y_2 - 4.0)/(24.625 - 0)$

$0.1967 = (y_2 - 4.0)/24.625$

$4.844 = y_2 - 4.0$

$y_2 = 8.844$ ft — This is the minimum required mounting height for this example.

Faded Fonts: How Difficulty in Information Processing Promotes Sensitivity to Missing Information

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Abstract /

Faded fonts on billboards and signage causes awareness of missing information. In this research we highlight the importance of fonts in advertising and wayfinding and how it impacts sensitivity to missing information. Across two studies, we demonstrate that disfluency caused by faded fonts can reduce omission neglect. Study 1 establishes the basis for consequences of disfluency on omission neglect as well as its effects on judgments. Study 2 demonstrates that disfluency increases awareness of missing information by reducing response time differences for correctly identifying previously presented versus missing information. Taken together, the two studies demonstrate that disfluency increases sensitivity to absent information. Practical implications to signage and theoretical contributions to research on omission neglect are discussed.

Keywords /

Faded fonts, Contrast recognition, Missing information, Disfluency

INTRODUCTION

Information on billboards and other signage is used to convey meanings, values, and features surrounding a product and has a big role to play when it comes to influencing consumer behavior. Past research has indicated the challenges of content inherent in billboards and the importance of continued research in this domain (Pieters, Warlop, & Wedel 2002; Dennis, Newman, Michon, Brakus, & Wright, 2010; Yoon et al., 2014). Despite extensive research on the effectiveness of visual information on billboards (Marlow, 2001; Huddleston, Behe, Driesener, & Minahan, 2018; Sundar, Gonsales, & Schafer, 2018; Wilson & Till, 2008; Dynel, 2011), textual information is often noted to be equally or even more effective than visual information in swaying consumer behavior (e.g., Kim & Lennon, 2008). Recent research, in fact, points to the fact that textual information can indeed be more effective than visual information in swaying human behavior (Castro & Horberry, 2004; Dillon, 2004; Toma, 2010). The literature indicates that an important consideration about textual information could be the font in which information is presented.

Fonts influence the impressions surrounding a brand (Henderson, Giese, & Cote, 2004). Furthermore, research indicates that fonts can influence both connotative meaning and emotion, which can eventually affect perception (Juni & Gross, 2008). Researchers note the importance of selecting fonts, which are used extensively in logos, in managing perceptions surrounding brand personality (Doyle & Bottomley, 2006). In addition to research on the inherent benefits of selecting the right font, the actual visibility of the font is also important (Coulter & Coulter, 2005). This is especially true with outdoor advertisements, which are only viewed for an average of five seconds (Davis, 1955). Past research demonstrates that it's necessary to have a balance between the textual and visual information presented in signage (Marlow, 2001). Bold fonts are often used to increase readability, as the higher visibility promotes fluency in the mind of the consumer. Faded fonts, other the other hand, are often used to trigger disfluency/difficulty to read information (Alter & Oppenheimer, 2008; Oppenheimer, 2008; Song & Schwarz, 2008).

Visibility in signage can break through clutter and is often combined with clear and readable messages (Taylor, Franke, & Bang, 2006). When designing content, businesses or organizations often assume that the signage should be clear and readable and try their best to avoid such disfluency (i.e. difficulty of processing information; Alter, Oppenheim, & Epley, 2013). Nevertheless, there are many practical reasons for fonts on billboards and other signage to be disfluent, including normal wear and tear caused by weather conditions and fading (Visual, 2016). Although faded signs are often indicators of economic hardship for a business, proprietors sometimes benefit by such signs (Sinfield, 2014). Alter, Oppenheimer, Epley and Eyre (2007) note that difficult-to-read lettering with reduced visibility reduces the impact of heuristics, defaults, and peripheral cues in judgments and improved syllogistic reasoning. Prior research on disfluency shows that attribution of the source of disfluency to the information increases deliberative, analytic processing (Alter et al., 2007; Diemand-Yauman, Oppenheimer, & Vaughan, 2011; Hernandez & Preston, 2013; Park, Herr, & Kim, 2016; Song & Schwarz, 2008). This can further encourage individuals to question their first impressions when engaged in decision-making or problem-solving (Alter et al., 2007; Song & Schwarz, 2008).

To show the bright side of disfluency, in the current research, we investigate the role of disfluency (versus fluency/easiness of processing information) as it influences awareness of missing information and subsequent judgment. We were interested in instances when participants generated or did not generate missing attributes due to disfluency (versus fluency). Specifically, we manipulated the disfluency/difficulty of processing information through the fonts in which signage appeared. The purpose of this research was to examine whether disfluency due to faded fonts would increase people's awareness of missing information and eventually improve their judgments. We predicted that when signage was difficult to process because of faded fonts, consumers would detect missing information more efficiently, process information more cautiously, and make more moderate judgments. We hope our findings offer meaningful implications for both companies and the public on how the fonts of signages in billboards and advertisements may impact consumer information processing.

CONCEPTUAL BACKGROUND

Awareness of omission

Awareness of information that is missing in signage, such as missing attributes, features, options, concerns, or possibilities, is surprisingly difficult (Sanbonmatsu, Kardes, & Sansone, 1991; Sanbonmatsu, Kardes & Herr, 1992; Sanbonmatsu, Kardes, Posavac, & Houghton, 1997; Sanbonmatsu, Kardes, Houghton, Ho, & Posavac, 2003). Omission neglect, or the failure to detect the absence of important information, usually leads to extreme judgments on the basis of limited evidence. The failure to notice that information is missing can encourage consumers to form extreme judgments as they focus only on the presented information. This is mainly due to the fact that the presented information is often overestimated, and the importance of missing information is underestimated (Sanbonmatsu et al., 2003; Unkelbach, Fiedler, & Freytag, 2007). Consequently, beliefs are held with a high degree of confidence and can be highly favorable or unfavorable even when available evidence is weak. As most advertisements focus on positive information concerning their brands and products, omission neglect in such contexts usually results in highly favorable beliefs and judgments. Despite the seemingly positive impact of omission neglect on judgment, it may increase regret in the future when targets find out about important missing information (Wu, Escoe, Kardes, & Wyer, 2018; Wu, Shah, & Kardes, 2016).

Because omission neglect is consequential, it is important to discover its determinants and antecedents. We find it surprising that limited research has been conducted to investigate its antecedents. Muthukrishnan and Ramaswami (1999) find that knowledgeable consumers who consider multiple factors when making decisions are sensitive to missing attributes. Kardes et al. (2006) demonstrate that when consumers are asked to consider the criteria used to judge a product before seeing an ad, they are more sensitive to missing information, and consequently, their product evaluations are less extreme. Both pieces of research suggest that when consumers engage in deeper processing, they become more sensitive to missing information. However, additional research on the antecedents of omission neglect is needed.

In the present research, we introduce a novel determinant of awareness of missing information. Specifically, we propose that disfluency, or the experience of difficulty during information processing (Schwarz, 2004), can mitigate omission neglect, resulting in less extreme but more stable judgments. Disfluent information is often unintentionally or intentionally presented to consumers. For example, small text, speedy dialogue, and difficult vocabulary frequently occur in the marketing context. Normal wear and tear can make a billboard or other signage difficult to follow. Although intentional and unintentional disfluency appear because of completely different reasons, both increase deliberation (e.g., Alter et al., 2007). As a consequence of increased deliberation, we predict that the experience of disfluency (e.g., a difficult-to-read font) may mitigate omission neglect by directing more effort toward the processing of information, and thus, increase the likelihood that consumers will recognize a lack of information. In other words, disfluent presentations of information signal to consumers that more effort needs to be expended to assess the sufficiency of presented information and thereby make an evaluation (Hernandez, Han, & Kardes, 2014). Finally, decreases in omission neglect, or in other words, increases in awareness of missing information, should lead to less biased judgements, lower perceived sufficiency of the presented information, and therefore, more moderate evaluations. To confirm the role of omission neglect, we attempt to rule the alternative explanation of attractiveness (Reber, Winkielman, & Schwarz, 1998). Prior research suggests that consumers may have less favorable evaluations because disfluency sometimes makes the source seem less attractive. In the present research, we show that even when the attractiveness is not affected, the disfluency effect on evaluations still occurs due to increased awareness of missing information.

Across two studies, disfluency was manipulated via easy-to-read versus difficult-to-read fonts through word-background color contrasts. Study 1 established a baseline for comparison of the consequences of disfluency on omission neglect as well as the effects of disfluency on judgment. It was anticipated that the difficult-to-read font would lead to lower omission neglect (e.g., lower perceived sufficiency of the presented information), leading to less extreme product evaluations. Study 2 used a novel response accuracy task to directly reflect omission neglect in the disfluent versus fluent conditions. We predicted that consumers would more readily memorize previously present (vs. absent) information by detecting it faster in the fluent condition but would memorize both previously present and absent information equally well in the disfluency condition. We also attempted to rule out *perceived attractiveness* as an alternative explanation in this study. Finally, although we used both billboards and on-site signage as stimuli in the studies to evaluate effects of contrast in signage, the implications in both these domains could take on different formats (i.e. faded fonts as deliberate stylistic character of place vs. off-site signage as a sign of economic decline, etc.).

STUDY 1

In Study 1, disfluency of fonts was manipulated via an easy-to-read word-background color contrast versus a difficult-to-read color contrast on a billboard. We predicted that compared to the easy-to-read color contrast, the difficult-to-read color contrast would lead to less extreme/favorable product evaluations. Furthermore, we predicted that the outcome on evaluation in our experiments would stem from decreased omission neglect. As disfluency may increase deliberative, analytic processing and encourage individuals to question their first impressions during problem-solving (e.g. Alter et al., 2007; Song & Schwarz, 2008), we predicted that disfluency should also increase consumers' sensitivity to missing information, or in other words, awareness of other important information that is absent. In this study, consumers' sensitivity to missing information was measured via perceived sufficiency and likelihood of missing information. When participants were insensitive to omissions, even a small amount of available evidence would seem sufficient for accurate evaluation. We predicted that the difficult-to-read color contrast would lead to lower perceived sufficiency, contributing to lower product evaluations. We also predicted it would directly increase the perceived likelihood of missing information.

Procedure

A total of 111 adult participants (42.6% male; M_{age} = 37.01) were recruited via an online resource (i.e. Amazon Mechanical Turk) and received compensation of a small amount of money. Participants were randomly assigned to one of two conditions in a two-cell (color contrast: difficult-to-read vs. easy-to-read) between-subjects design.

Participants were asked to imagine that they saw an advertising billboard on their walk home. In particular, they were invited to evaluate a protein bar based on a picture and attribute information (see detailed stimuli in Appendix A1 and Appendix A2). The attribute information was described either in black-and-white or in light grey-light blue color contrast. In a pretest of the same subject pool, 108 participants rated how easy or difficult it was to read the attribute information (1 = *very easy to read*; 9 = *very difficult to read*). Based on the pretest, the light grey-light blue contrast (M = 7.44) was more difficult to read than the black-white contrast [M = 3.20; F(1, 106) = 82.74, p < .001].

After viewing the advertisement, participants reported their overall evaluations of the protein bar (1 = *very bad*; 9 = *excellent*) and the perceived sufficiency of the information given for them to make a correct evaluation of the bar (1 = *not sufficient at all*; 9 = *extremely sufficient*). Afterward, we directly asked participants how likely it was that relevant information was missing (1 = *extremely unlikely*; 9 = *extremely likely*). Finally, demographic information was collected.

Results

A one-way ANOVA performed on the overall product evaluations revealed less favorable and less extreme evaluations in the difficult-to-read light grey-light blue color contrast condition (M = 5.09, SD = 2.11) than in the easy-to-read black-white color contrast condition [M = 5.91, SD = 1.82; F(1, 106) = 4.62, p = .034]. Participants reported that the given information was less sufficient when viewing the difficult-to-read color contrast (M = 3.74, SD = 2.55) than when viewing the easy-to-read color contrast [M = 5.83, SD = 2.00; F(1, 106) = 22.55, p < .001]. To determine whether perceived sufficiency accounted for the variations in the overall evaluation of the product, a mediation analysis was conducted (Hayes, 2012; Model 4; Bootstrap: 5000). As predicted, it mediated the relationship between color contrast and evaluation extremity (95%; CI: -1.77 to -.74). Importantly, difficult-to-read color contrast also led to higher perceived likelihood of missing information than easy-to-read color contrast [$M_{difficult\text{-}to\text{-}read}$ = 6.76, SD = 1.78 vs. $M_{easy\text{-}to\text{-}read}$ = 5.57, SD = 2.04; F(1, 106) = 10.33, p = .002]. As predicted, it was negatively correlated with perceived sufficiency (r = -.25, p = .01).

Discussion

Consistent with prior research (e.g. Reber et al., 1998), Study 1 showed that disfluent information led to less extreme evaluations. Nevertheless, contrary to what Reber and colleagues (1998) suggested, we found that disfluency led to less extreme evaluation even when the perceived attractiveness was not altered. Study 1 showed that difficult-to-read color contrast enhanced sensitivity to missing information, which was a novel consequence of disfluency. When the color contrast was difficult to read, participants perceived the information as less complete, contributing to less extreme/favorable evaluations.

STUDY 2

A novel response time paradigm was used in Study 2. Prior research shows that response time increases as the difficulty to finish a task increases (Bargh & Chartrand, 2000; Fazio, 1990). Because missing attributes are more difficult to detect compared to presented attributes, response time for the correct identification of missing attributes should be slower than response time for the correct identification of presented attributes. In other words, when information is easy to read, participants should be faster to detect previously present information than previously absent information. However, when information is hard to read, we predicted that participants would be equally fast to detect both types of information. This was because differences in response time as a function of whether the attribute is missing or not would be less pronounced when information is hard to process.

Procedure

A total of 97 participants (45.3% male; M_{age} = 36.92) were recruited via an online resource and received a small monetary compensation. Participants were randomly assigned to one of two conditions in a two-cell (color contrast: difficult-to-read vs. easy-to-read) between-subjects design.

Participants were asked to imagine that they saw a bus stop advertisement (see Appendix B1 and B2). Specifically, participants evaluated a laptop computer based on a picture and four pieces of information. The information was shown either in easy-to-read black-white or in difficult-to-read light grey-light pink color contrast. The information presented with the difficult-to-read contrast was expected to be difficult to read but readable with effort. After viewing the information, participants reported their overall evaluations (1 = *very bad*; 9 = *excellent*), how much attention they paid to the ad (1 = *very little*; 9 = *very much*), the perceived sufficiency of the information (1 = *not sufficient at all*; 9 = *extremely sufficient*), and how attractive they thought the ad was (1 = *not pretty at all*; 9 = *very pretty*). In addition, a pretest with the same subject pool showed that the information was indeed more difficult to read in light grey-light pink than in black-white contrast conditions [M = 7.09 vs. M = 3.92; $F(92) = 50.43$, $p < .001$].

Next, participants completed a response time task. They were asked to respond as quickly and accurately as possible and to emphasize accuracy over speed. Eight pieces of attribute information (four previously presented and four not-previously presented attributes) about the laptop were presented one at a time on a monitor, and for each attribute, participants were asked to press a button labeled "present" or a button labeled "absent" to indicate whether the attribute was either present or missing in the target ad. The attributes were randomized to control for order effects. Participants concluded the survey with demographic measures.

Results and Discussion

Self-reported measures. A one-way ANOVA performed on overall product evaluations showed that participants tended to form less extreme evaluations in light grey-light pink than in black-white contrast conditions [$M_{difficult\text{-}to\text{-}read}$ = 5.67, SD = 1.30 vs. $M_{easy\text{-}to\text{-}read}$ = 6.51, SD = 1.43; $F(95) = 8.98$, $p = .003$]. Participants reported that the information was less sufficient when viewing difficult-to-read color contrast (M = 4.46, SD = 2.36) than when viewing easy-to-read color contrast [M = 5.41, SD = 2.27; $F(1, 95) = 4.11$, $p < .05$]. As in Study 1, the perceived sufficiency mediated the relationship between color contrast and evaluation extremity (95%; CI: -.57 to -.02). Importantly, the color contrast impacted neither attention [$M_{difficult\text{-}to\text{-}read}$ = 5.43, SD = 2.34 vs. $M_{easy\text{-}to\text{-}read}$ = 6.10, SD = 2.30; $F(95) = 1.98$, $p = .16$] nor perceived attractiveness [$M_{difficult\text{-}to\text{-}read}$ = 4.63, SD = 2.07 vs. $M_{easy\text{-}to\text{-}read}$ = 5.10, SD = 2.37; $F(95) = 1.06$, $p = .31$]. The results on attention and attractiveness ruled out as two alternative explanations.

Response time. A within-subject ANOVA performed on response time showed that participants responded faster to previously presented than to missing information [$M_{present}$ = 3.73s vs. M_{absent} = 4.51s; $F(93) = 17.24$, $p < .001$]. No main effect for color contrast was found ($F < 1$). Most importantly, there was an interaction between color contrast and attribute presence/absence [$F(1, 93) = 4.54$, $p = .04$]. When the contrast was easy to read, participants responded faster to previously presented than to missing information [$M_{present}$ = 3.70s vs. M_{absent} = 4.86s; $F(1, 50) = 28.77$, $p < .001$]. When the contrast was difficult to read, this difference disappeared [$M_{present}$ = 3.77s vs. M_{absent} = 4.15s; $F(1, 43) = 1.46$, $p = .23$], indicating that participants were more sensitive to missing information in this condition. There was no effect of contrast and information presence/absence on response accuracy ($F < 1$), suggesting that participants followed the instructions to weigh accuracy over speed and that they could clearly read information in both conditions.

Using a different measure of sensitivity to missing information, Study 2 showed that disfluency increased recognition of missing information by reducing response time differences for correctly identifying previously presented versus missing attributes. When the contrast was difficult to read, differences in detecting present and absent information were lower than when the contrast was easy to read. The results suggest that participants were indeed more sensitive to missing information when presented information was more difficult to process. Together, Studies 1 and 2 provide converging support for the hypothesis that disfluency/difficulty increases awareness of absent information.

General discussion

The purpose of this research was to explore the role of disfluency on awareness of missing information. While easy-to-read signages are commonly chosen over hard-to-read ones, our findings suggest that signages that are hard to read due to faded fonts may have some positive impacts. Our findings are consistent with and lend further support for the effect of disfluency on deliberative, analytic processing (e.g. Diemand-Yauman et al., 2011), as well as for the effect of disfluency on questioning and reconsidering first impressions (Alter et al., 2007; Song & Schwarz, 2008). Our research suggests that disfluency due to faded fonts of signages leads to increased awareness of missing information that is typically neglected. This increased awareness of missing information in turn decreases the extremity of evaluations and may improve consumer information processing.

Our research is of critical importance to businesses, consumers, and public policy makers. Presenting information fluently through clear fonts can induce extreme judgments and neglect of important information that is absent. On the other hand, presenting information disfluently through faded fonts can encourage consumers to process information more cautiously. While signage communicators usually want positive audience reactions, it is often important and ethical to encourage the target audience to make cautious and stable judgments and decisions. Neglecting important information because of fluency may have highly negative consequences. If the audience's reactions are positive only because important absent information has been neglected, the impact can be more harmful than beneficial. For instance, neglecting absent side effects of a medication may lead to severe health issues. In this case, it is crucial that both doctors and patients are aware of the side effects, either present or absent in the current communication. Our findings suggest that one way to remind audiences of unknown information is to present information in harder-to-read signs.

As signages are crucial to any forms of adverting, including billboards, they should be balanced based on the image and message a firm wants the consumer to process and the way in which they want them to process it (Sundar, Dinsmore, Paik, & Kardes, 2018; Sundar, 2018). Recall of textual elements is the lowest percentage based on Pieters and Wedel's (2004) research on magazine advertisements and is further reinforced by the "sake of exposure time" (Marlow 2001), but textual elements can be more effective, for example, in advertising at an airport where there are constantly long lines, according to Wilson and Till (2008). Based on Taylor, Franke, and Bang's (2006) work, visibility as a channel of decluttering, readability, and clarity is the most important element of a billboard. It draws consumers into a physical store more than the gravitational model of placing billboards in close proximity to a store and focusing mostly on nearby potential shoppers, but it can collaborate with that model as well.

While the current research focuses on advertising billboards, future research might explore how disfluency impacts information processing on other communication media. Future research might also examine whether disfluency triggered by elements other than faded fonts lead to similar results. It is worth expanding upon the practical implications of disfluency's effects on both short- and long-term brand reputations to better inform future marketing activities. It is possible that disfluency benefits long-term reputations in particular because it encourages consumers to make more cautious judgments and decisions. Furthermore, future research could also explore moderators that drive responses to disfluency. It is possible that individual traits such as critical thinking and the need for closure may affect how individuals respond to disfluency. Whereas disfluency may be a good debiasing technique for some people, it may not work on others. We hope our investigation of disfluency's effects on awareness of missing information in the context of billboard signage presents meaningful implications and opportunities for future research.

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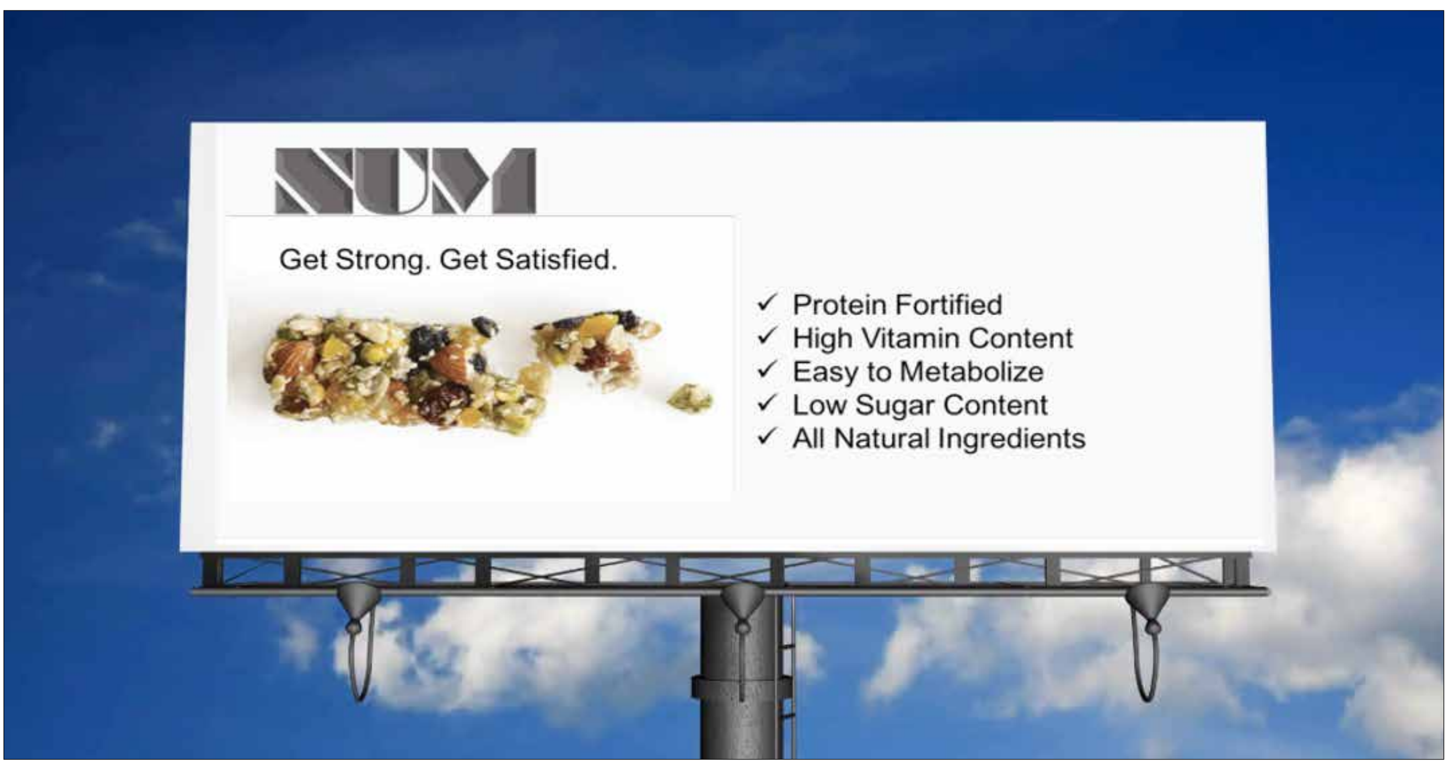
APPENDIX A1

Difficult-to-read advertising billboard used in Study 1

APPENDIX A2

Easy-to-read advertising billboard used in Study 1



APPENDIX B1

Easy-to-read contrast color used in Study 2

APPENDIX B2

Difficult-to-read contrast color used in Study 2

APPENDIX C

Summary of Studies

Study 1		
	Difficult-to-read	Easy-to-read
Product Evaluations	5.09 (2.11)	5.91 (1.82)
Perceived Sufficiency	3.74 (2.55)	5.83 (2.00)
Likelihood of Missing Information	6.76 (1.78)	5.57 (2.04)

Study 2		
	Difficult-to-read	Easy-to-read
Product Evaluations	5.67 (1.30)	6.51 (1.43)
Perceived Sufficiency	4.46 (2.36)	5.41 (2.27)
Response Time		
	Difficult-to-read	Easy-to-read
Present Information	3.77ms	3.70ms
Absent Information	4.15ms	4.86ms

Reviewing Two Street Blocks in Downtown Salt Lake City: Towards Re-envisioning the Circulation Spaces and Passages

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INTRODUCTION

This paper offers the perspective that architecture should be considered and seen as public art. Accordingly, this paper adopts an interdisciplinary perspective to the study and practice of art and architecture. Along these lines, the paper will discuss a proposal by Urban Art Lab in the SixtyNine-Seventy Competition, which called for the conceptual "re-envisioning" or re-imagining of two street blocks (69 and 70) in downtown Salt Lake City in Utah. Urban Art Lab's entry for the competition was an urban cluster within two Salt Lake City blocks that consisted of installations, art interventions and new public spaces.

THE CITY ACTS LIKE A MUSEUM ITSELF

Architecture is not only about buildings, but it is a wider cultural phenomenon that pertains to ideas as well as to discourse and practice and retains a pervasive presence through every part of our daily lives. Indeed, architectural works are also public art and should be seen and considered as such. Therefore, architects and artists should add something valuable and enriching to the culture with every design gesture or detail that they insert into the architectonic outlay of the city. Of course, this artistic representation through architecture translates and transmutes into many meaningful gestures that an architect makes through building designs.

This artistic communication also leads into cultural discourses that inspire new ideas that affect the configuration of cities and the way we live. This synergy between art and architecture in the emergence of certain popular trends such as performance architecture. Examples of this movement are reflected in Pedro Gadanho's "Back to the Streets: The Rise of Performance Architecture." Gadanho's work represents an intellectual perspective called "tactical urbanism," a "transient community urban action" that was initiated by architects and artists working collaboratively to re-engage with and re-imagine the city.[1] It traces back to the performing arts movement of the mid-1960s and 1970s, which is based on the idea that the city could act like a museum itself.

It should also be noted that performance architecture is a subset of tactical urbanism, and they both have a long history that traces back to earlier art movements such as the "situationists," the "fluxus" and the "happenings." Today, these earlier historical progenitors are reflected in the works of younger contemporaries such as: the Argentinean architect and artist, Tomás Saraceno (*In Orbit*, 2013); the Danish-Icelandic artist, Olafur Eliasson (*The Weather Project*, 2003); and the architects of Raumlabor Berlin (*Kitchen Monument*, 2006 and *City Mattress*, 2008).

Tactical urbanism is a transient and interdisciplinary laboratory for creating new urban experiences, and it is deployed to initiate or encourage the development of aesthetic and sustainable built environments. This urban movement promotes various temporary, low-cost interventions that are targeted at improving urban design. Such urban interventions include art installations, performances, happenings, etc., and they are intended to help promote and effectuate positive changes in urban neighborhoods and communities.

Tactical urbanism is focused on improving the livability of cities, and this functionally starts at the level of the street, the block or the building. These small-scale experimental improvements to the built environment are increasingly seen as ways to stage interventions and investments that are more substantial and permanent. These catalytic actions are often called various names, including guerrilla urbanism, pop-up urbanism, city repair or even do-it-yourself (DIY) urbanism.

SIXTYNINE-SEVENTY, THE SPACES BETWEEN: AN URBAN IDEAS COMPETITION TO RE-ENVISION CIRCULATION SPACES AND PASSAGES OF TWO BLOCKS IN SALT LAKE CITY

This urban ideas competition was a 2013 design competition that invited design teams from around the world to re-envision the circulation spaces and passages of two blocks (69 and 70) in downtown Salt Lake City. As the SLC Downtown Plan notes: "*The competition aimed to address the downtown as a major destination for culture, civic, and commercial activities, and as a growing residential neighborhood, seeking to develop the synergies across both noted in the Salt Lake City Downtown Plan.*"[2] The competition was organized by the AIA Utah Young Architects Forum and the Downtown Alliance in collaboration with Utah Heritage Foundation. Ultimately, the competition attracted the participation of 200 architects and designers who came from 48 countries across the globe.

The products or outcome of the urban ideas competition were not intended to be realized or translated into built projects because the project sites were mostly privately owned. However, there were two project sites of large land holdings that were public—one owned by the Redevelopment Agency of Salt Lake City and the other owned by Salt Lake County. Although initially there was no guarantee that the competition proposals would be realized or actualized, the Planning Department of Salt Lake City later seemed to show interest in utilizing the outcome or products of the competition and in incorporating potential ideas into the new downtown masterplan. Eventually, the SLC Redevelopment Agency used some of the ideas to create the new downtown masterplan.

COMPETITION SITE: SALT LAKE CITY DOWNTOWN

Salt Lake City is the capital city of the state of Utah; it is also the county seat and the largest city in the region and had an estimated population of 200,500 in 2017.[3] The downtown area is comprised of 10 smaller districts, each with its own character and identity. Blocks 69 and 70 are parts of the Central Business District, which serves as an important economic and cultural hub for the city and the greater Wasatch Front metropolitan region. A large portion of the competition area and its surroundings are part of a significant national cultural historic area. The competition information package states that "*Salt Lake City boasts a stunning natural setting, cultural amenities, a vibrant retail core, and a thriving and extensive business community. However, it lacks connection between these elements.*"[4]

The organizers of the competition were looking for proposals designed to increase the livability of this district from a former destination to a neighborhood. The Redevelopment Agency of Salt Lake was hopeful that the outcome of the competition proposals would help to support the new Downtown Plan (May 2016), which was a long-term growth and development plan. The Agency sought to implement this Plan "*by* *encouraging private sector investment and job creation, upgrading various transportation modes, assisting the cultural core, creating a green loop, improving high-density residential development in various forms and directing proper investment of public funds.*"[5]

The competition was a way of collating ideas that would help the agency to implement a development plan. As described in the competition brochure: "*The vision of the competition was to harness fresh and provocative design ideas and to activate the spaces between the disparate arts, entertainment, and business groups on blocks 69/70, amplifying Salt Lake City's cultural amenities and acting as a catalyst for design-led growth.*" Furthermore, the brochure notes that: "*The competition in its entirety was about interstitial space. It was not about the design of new buildings, but about the relationships between them and other aforementioned elements.*"[6]

Salt Lake City's Central Business District is defined by main-street shopping, the tallest buildings in the city, and arts and cultural institutions. The area also has a strong financial and retail district as well as a rich stock of historic buildings. As noted in the competition brochure, Blocks 69/70 are also in "the center of Salt Lake City's cultural center, which is the designated hub of over 100 major cultural and arts organizations."[7] This cultural center acts as a central location for various urban activities including performance art, visual art and cinema, as well as shopping, dining and religious venues.

HISTORY OF BLOCKS 69 AND 70 AND CURRENT LAND USE

Blocks 69/70 stand at the heart of the city and straddle Main Street. These two blocks have a history that dates back to the first pioneer settlers, and they have been utilized for variety of urban purposes. The two blocks may be best known as the home or the first location of the Zion's Cooperative Mercantile Association department store. They also house several theaters, including the Utah and Capitol Theatres, as well as prominent banking institutions and publishing outfits like the Arrow Press and Salt Lake Tribune.

As the commercial district of downtown Salt Lake City grew through the mid- and late-1800s, some blocks were divided into two with new streets or walkways opened up to create the Downtown Mid-Block Walkway network. The current land use in the designated area is a mix of institutional, office, retail and recreational uses. However, more than a third of all developable land in all downtown districts remains vacant or underutilized.

The two blocks have 12 vacant buildings and six parking garages in addition to many undeveloped parking lots. The primary use of land in the downtown area serves a diversified range of urban purposes. The largest institutional landholders are LDS Church and Salt Lake City in addition to the state and federal governments. Besides these institutional land uses, the downtown area also serves industrial and parking purposes. Of course, as a Salt Lake City publication notes, while functional, these industrial and parking facilities are not very conducive to a pleasant pedestrian experience.[8]

URBAN ART LAB'S COMPETITION PROPOSAL FOR BLOCKS SIXTY-NINE AND SEVENTY

Urban Art Lab was founded in 2013 by a collaborative group of architects and artists that included Charlott Greub, Jeremy Bringard, Bradison Brinton and Joerg Ruegemer. It was based in Salt Lake City and formed a creative platform for partaking in the SixtyNine-Seventy competition. Urban Art Lab submitted a competition entry that was designed in the form of an urban cluster celebrating the arts, sciences and technology. Anchored on the ideas and principles of tactical urbanism, Urban Art Lab sought to create connections between new public spaces within Blocks 69 and 70 and beyond.

Based on the thesis that Downtown Salt Lake City is a destination and not a neighborhood, Urban Art Lab's proposal focused on the redesign of the "junk spaces" within the two-block competition area through pop-up planning, with a strong emphasis on community engagement projects. We emphasized the implementation of artistic interventions that contribute to place-making, promotion and programming connectivity within the cultural core of Salt Lake City. In addition, we sought to bring life and a renewed energy to the public realm through additional elements, such as street furniture and signage as well as planting, lighting and enriching the primary routes or major connective corridors with trees.

These artistic and architectural endeavors were consistent with the aspirations of the SLC Downtown Plan. We sought to actualize the city's aesthetic for a public realm, which the Downtown Plan rightly and succinctly understood as: "*...the roadways, sidewalks, parks, plazas and other open spaces that comprise the arteries and focal points of the downtown. It is the main space where civic interaction occurs and is often defined in contrast to private property. A successful public realm promotes a dynamic social and civic experience and is the result of the interplay between the built form of a city, the engineering and design of infrastructure systems, and functional programming of space.*"[9]

The public realm is a vital aspect of the built environment, so it is desirable to create a regulatory framework that allows pop-up planning in a spontaneous way without having to control every single detail through ordinances. It was clear that connectivity or walkability was one of the most important factors that had to be improved in Salt Lake City's downtown area. So, Urban Art Lab proposed physical connections through Blocks 69 and 70 that offered multiple routing options to a diverse range of activities, services and places, while at the same time encouraging physical activity. The desired trend was to see more people walking, biking or using transit.[10] Walkability builds community, building equal access to all people, cultures and activity. Urban Art Lab suggested publicly-driven interventions including guerrilla installations, art containers, events, installations and activities.

These public interventions were to take over abandoned and underutilized spaces in Blocks 69 and 70 with a view to transforming them into usable public spaces that would help to create an engaging and walkable downtown. Interventions such as spatial occupancies might be expected to have a temporary character, whereas others provide a more permanent urban enrichment and offer a refreshing and democratic contrast to the consumption-driven City Creek Center Shopping Mall project to the north. The proposal also included several elements that overlapped the physical and digital space. Through these elements, new platforms of urban expression were expected to emerge and offer a mélange of cultural, communal and educational activities that would be expected to slowly take over the new public center of Salt Lake City.

PROPOSED DESIGN ACTIONS AND LOCATIONS (FIGURES 1 AND 2)

Block 69: Urban Living Room + Urban Market + Zion's Beer Garden in a Park Covered by a Parasol Roof

Urban Living Room (Figure 3). Proposed locations and activities in Block 69 are a new pocket park, called the Urban Living Room that functions as the city's lung and that provides flexible, urban recreation space in the center of the downtown area. A farmers market and beer garden are included as part of this new urban park. To support a better microclimate in Block 69, the Urban Living Room is covered by a natural roof of trees in addition to a supplemental man-made roof structure, or the Parasol Roof. This roof provides shade during the hot summer months and is capped with


6970 Urban Art Lab Proposal
Awarded Urban Design Competition: The Spaces Between: SLC
August 22, 2013 – Urban Art Lab

Figure 1

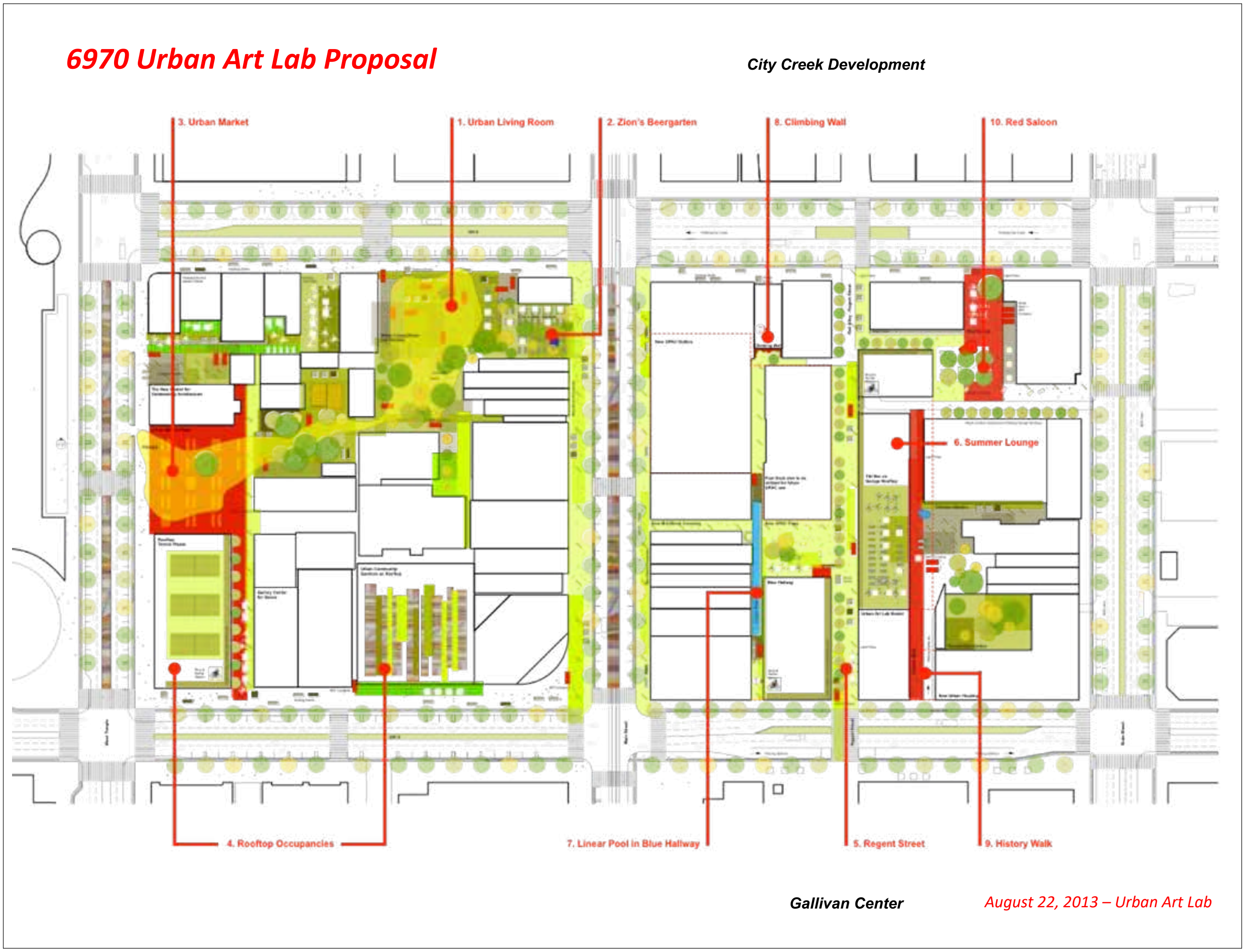
6970 Urban Art Lab Proposal
City Creek Development
3. Urban Market
1. Urban Living Room
2. Zion's Beergarten
8. Climbing Wall
10. Red Saloon
6. Summer Lounge
4. Rooftop Occupancies
7. Linear Pool in Blue Hallway
5. Regent Street
9. History Walk
Gallivan Center
August 22, 2013 – Urban Art Lab

Figure 2

Figure 3

an array of photovoltaic cells to generate energy that is used directly by the container installations and the farmers market.

Using a permeable pavement in the form of a greenfield throughout the entire park area contributes positively to a healthier urban microclimate.[11] The performative and artistic flexibility of the proposed park offers an important anchoring function for an expanding repertoire of future interventions or activities. Such interventions would include: publicly-driven guerrilla installations; art containers; multi-media projection; multifunctional street furniture; living walls; urban farming; farmers market; roof-top sports facilities; and community gardens. To be sure, these artistic interventions would help to create a new center that would enhance and enrich Salt Lake City's future social and urban development.

Urban Market (Figure 4). The Urban Market becomes downtown's new daily farmers market. This function provides necessary support for downtown dwellers and offers a welcome supplement to the new grocery store that stands just one block away.

Zion's Beer Garden (Figure 5). A beer garden at the corner of Main Street and 100 South follows the model of a traditional Munich, Germany open-air tavern, providing a social and interactive space where one's own food can be brought in, to be supplemented by drinks purchased at the beer garden. A small playground takes care of the children, and the adjacency to the city's Urban Living Room provides participation in events that are offered there.

Urban rooftop occupancy. As part of the more permanent interventions, the authors propose a variety of urban rooftop interventions. The underutilized

Figure 4

Figure 5

rooftop of the parking garage in Block 70 transforms to regionally popular summer bars; other roofs in Block 69 turn into community gardens, a tennis court and an observation deck. These functions not only add to the attractiveness of downtown Salt Lake City, they also help to minimize the heat island effect during the hot summer months.

Recurring Design Action in Blocks 69/70

Art and events containers. A flexible artscape of recognizable red shipping containers are distributed throughout Blocks 69 and 70, creating a sub-culture as well as professional projects, exhibitions and exceptional art events. These containers provide endless opportunities and venues for various entities and service providers to express their work or projects and to showcase their service offerings. Such entities would include local artists, universities, companies, schools, the city government and individuals.

Multifunctional urban modular street furniture (UMSF). UMSF are provided throughout the entire competition site to initiate outdoor activities, recreation, social equity and social interaction. These are multifunctional flexible elements made of coated EPS for outdoor use in designated public spaces within and beyond Blocks 69 and 70. These modules can be arranged and rearranged as decorative blocks for a variety of social needs that include sitting, playing and sleeping or reading. The special geometry and low weight allow for endless possibilities and formations. UMSF can be arranged as furniture—for example, a bar or stage—and can be transformed into a comfortable interior room by simple means of scaffolding.

Smartphone as an interactive public interface. Today's accessible, popular smartphone technology allows for a setup of a variety of interactive events and participatory projects. A special filter allows the public to display individual images on media screens that illuminate the buildings' underused firewalls. A Salt Lake City app is being used by urban dwellers and visitors to navigate the newest events, exhibitions and more by receiving updates and background information on these activities. Another app named Commons' is created to encourage Salt Lakers to "compete to do good" and by doing so helping to improve the city. Salt Lakers are challenged to identify problems in urban spaces and suggest ways to improve them. The users of this app can also vote for each other's ideas to identify the most popular proposals.

Green Loop: Grey goes green. The Green Loop is a linear park network that integrates social spaces with green infrastructure, utilizing parts of downtown Salt Lake City's wide public streets. Festival streets or Grand boulevard streetscapes will have a renewed role as places for both people and vehicles. The Green Loop introduces new urban landscapes like living walls in reference to Patrick Blanc, a French botanist known as the founding father of the vertical garden. His green walls are transformative art pieces and create shades of green on what was hitherto merely dull concrete.

Bicycle stations. Strategically positioned bicycle rental hubs provide for necessary, instant and sustainable individual transportation. These stations

Figure 6

are also equipped with pumps and tools to allow for quick fixes of both private and rental bikes. These stations become part of a larger bicycle rental program within Salt Lake City.

Block 70: Regent Street and the Red Saloon, Blue Hallway and History Walk (Figure 6). The Midway Block Alley Regent Street and the Red Saloon on Block 70 will become the new physical manifestation for the Arts, Architecture and Design. A new art district with exhibition spaces that support "Storefront Studios" would be offered to artists, designers and small firms of the creative industries. These spaces would be affordable and centrally located to enable occupants to create, produce and communicate. Simultaneously, there would be some necessary support spaces (such as small coffee places, restaurants, bars and art galleries) to make the area a successful business incubator for small startup firms in the fields of Art, Design and Architecture.

Summer lounge and rooftop occupancies. These are seasonal urban recreation or sports facilities (that may come with sport bars) that may be located on rooftop locations.

Linear public pool and climbing wall in the Blue Hallway (Figures 7 and 8). A proposed section of Block 70, called the Blue Hallway, holds a public pool and climbing wall that offer social interaction, relaxation and stress relief in the heart of downtown. No other public sports facilities currently exist in this district. The adjacent wooden decks of the pool provide opportunities for aerobics and low-impact exercises. These decks also function as exterior space and are directly adjacent to the Utah Performing Arts Center (UPAC). During the winter, the pool is

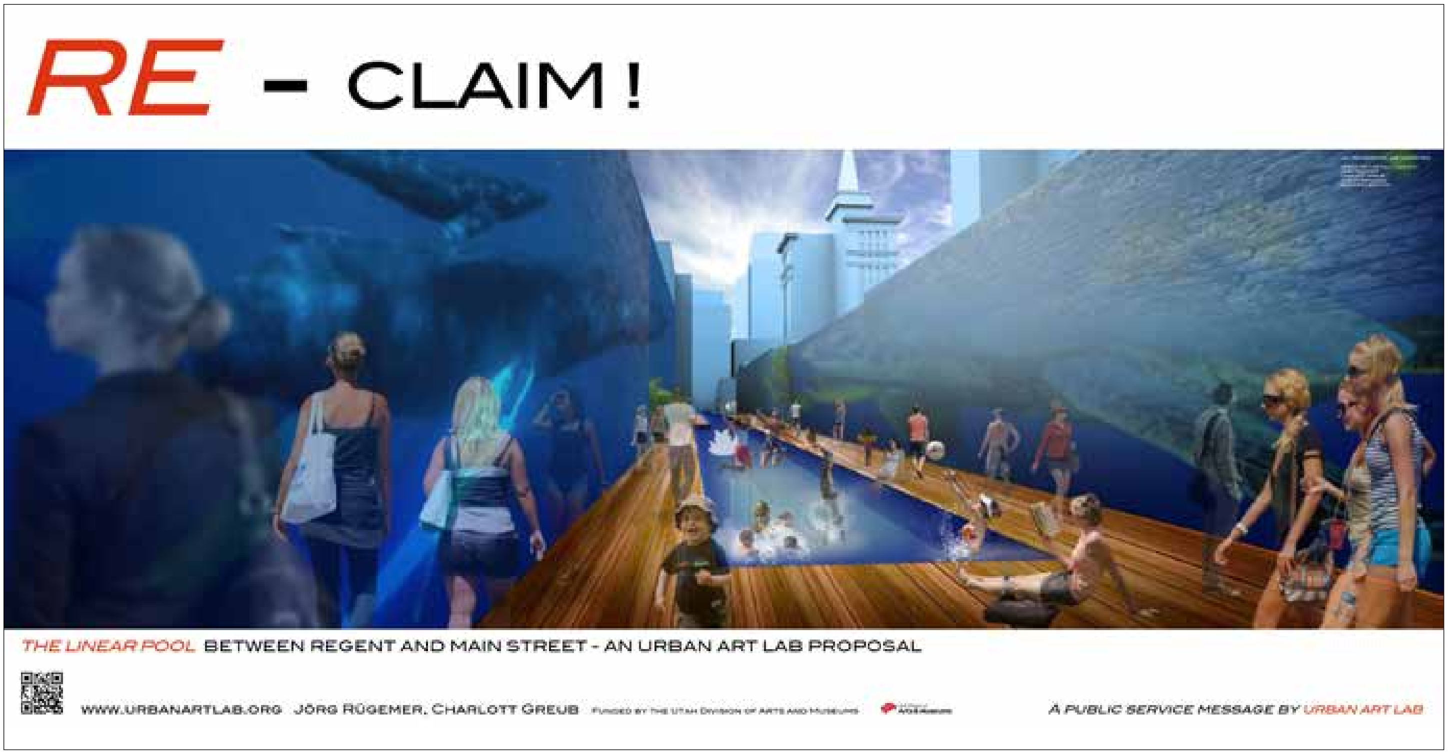

Figure 7

Figure 8

Figure 9

transformed into a linear ice rink, spanning the new urban plaza between the Blue Hallway and Regent Street. The climbing wall is located at the end of the Blue Hallway and is visible from the decks of the pool. In the United States, sport climbing is the most rapidly growing type of climbing and involves high-intensity, difficult climbing on relatively short routes[12]. The Blue Hallway is accompanied by interactive media projections that could be adjusted for the flexible use of the overall space.

History Walk (Figure 9). The History Walk is a reclamation of the former Chinatown district. Its purpose is to incentivize preservation and reuse of character-contribution buildings that will help to establish a history-conscious trail that would narrate the story of the city while physically linking historical and cultural landmarks throughout the downtown. The proposal for Plum Alley, currently used as a parking lot, was to become an area occupied by an Asian Market in concert with a Chinese restaurant and cultural institutions. The History Walk lets visitors and urban dwellers experience the chronicle of the place, while simultaneously offering the visitors places to rest and relax, such as a small Chinese Garden.

Multi-media art projection. It was proposed that digital projections on underused firewalls be utilized to illuminate streets and alleys and to transform the downtown landscape into an inviting and stimulating atmosphere for people to gather and enjoy the city. This will help to support and encourage science, technology and culture, especially among the young and under-privileged. The projections would create an accessible, affordable and educational public art experience. For example: prominent artists like Louie Psihoyos and Travis Threlkel could be invited to project digital images of endangered species onto downtown high-rise buildings. Such artistic events would be intended to draw attention to the plight of such endangered species while helping to launch activities like March for Species Racing Extinction. Through pairing with smartphone interfaces, these events would provide a forum for the public and emerging multi-media artists to experiment and interact. These artistic events would help to generate a dialogue about emerging art forms within and beyond the community while simultaneously serving to challenge, re-imagine and enrich the life of the city.

CONCLUSION

Three years after the competition in 2016, some of the ideas offered in the proposal of the Urban Art Lab became an important element in the new SLC Downtown Plan. On a professional note, it was most gratifying that out of the five key moves that were embraced in the SLC Development, three of the key moves were extracted from the ideas proposed by the Urban Art Lab. The three key moves that were inspired by and extracted from ideas from the Urban Art Lab are outlined below.

The first incorporated key move pertains to the idea of strengthening the cultural core through art interventions, etc. The May 2016 Downtown Plan seeks to give support to: "*existing cultural venues and organizations … [and to] explore opportunities to develop the spaces in-between such as parking lots, mid-block walkways and vacant properties between established activity centers throughout the cultural core.*" Furthermore, the Plan encourages "infill development" and seeks a modification of the "*zoning regulations to remove barriers so that development that helps implement the Downtown Plan is easier to realize.*"[13]

Additional examples of in-between or infill development art interventions would include promoting pop-up planning, street furniture, plantings and public art in addition to other elements such as arts events and art containers. This key move is intended to support the city's cultural landscape by re-imagining cultural venues through art interventions that strengthen Salt Lake City's cultural assets and bringing life and richness to the public realm.

The second incorporated key move pertains to the idea of creating a recreational and ecological environment in the form of a linear park or Green Loop. The May 2016 Downtown Plan seeks to give support to the development of a "*new linear park system that provides space for recreation and ecological services.*"[14]

Consistent with the ideas proposed by Urban Art Lab, the Downtown Plan seeks to: "*develop a tree planting program for the downtown that has urban qualities … maintain an expanded urban forest in the downtown area … [and to provide a] significant tree canopy that can effectively shade the public realm and reduce urban heat island effect.*" Furthermore, the Plan seeks to "*incentivize use of vegetation to minimize building cooling requirements, reduce urban heat island effects, manage storm water runoff, and promote air quality awareness and education.*"[15]

The third incorporated key move pertains to the idea of "*Sports Expansion and Retention*," which seeks to promote the expansion of sports recreational facilities in outdoor areas or on rooftops. The Development Plan notes that: "*sports and entertainment are an important component of the 24-hour city*" and that a proposed section of Block 70 would accommodate a public pool and climbing wall in the downtown area.[16]

This paper has presented the perspective that architecture should be considered and seen as public art. It adopts an interdisciplinary perspective to the study and practice of art and architecture. A proposal by Urban Art Lab in the SixtyNine-Seventy Competition was discussed. The proposal called for the conceptual "re-envisioning" or re-imagining of two street blocks (69 and 70) in downtown Salt Lake City in Utah. Urban Art Lab proposed ideas for an urban cluster within two Salt Lake City blocks that consisted of installations, art interventions and new public spaces.

Indeed, the elements of connectivity and walkability were the most important variables that were in need of creative and artistic improvements in the Salt Lake City downtown area. Urban Art Lab proposed physical connections through Blocks 69 and 70 that offered multiple routing options to encourage physical movements and pedestrian mobility for a diverse range of activities, resources, services and places. Urban Art Lab sought to deploy artistic interventions with Blocks 69 and 70 in creative ways that would have more people walking, biking or using transit. Walkability builds community while giving equal access to all people, cultures and activity.

ENDNOTES

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