

## **Reflective Trim on Clothing: Desirability Indicated by Purchase Preference**

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### **ABSTRACT**

Motor vehicle crashes involving pedestrians result in 1.8 deaths per 100,000 population annually in the U.S. Most of these fatalities are attributed to pedestrians not being seen in time for the driver to avoid a collision, particularly under poor visibility conditions. Previous research shows that reflective clothing worn at night can substantially increase pedestrians' visual conspicuity to drivers. The purpose of the present research was to examine people's desire for reflective trim on their clothing. Findings of strong desirability for reflective trim could prompt its incorporation into garments available to the public, and thus, potentially decrease pedestrian-related motor vehicle accidents. The present study measured the extent to which people are willing to pay extra or less for clothing with reflective material compared to the same items without reflective material. People reported they are willing to pay more for reflective material on sports-related, children's and inclement-weather clothing. Implications for safety and future research are discussed.

### **INTRODUCTION**

Pedestrians are at high risk of being hit and killed by motor vehicles (Cassidy, Brooks & Anderson, 2005). Approximately half of all motor vehicle crash fatalities involve pedestrians, resulting in 1.8 deaths per 100,000 U.S. population annually (Langham & Moberly, 2003). On average, a pedestrian is killed in a traffic crash every 108 minutes and injured every eight minutes (NHTSA, 2005).

One of the primary causes of public road crashes involving pedestrians is lack of conspicuity (Shinar, 1978; Owens & Sivak, 1993, 1996). Under conditions of poor visibility such as at night, pedestrians may not be seen in enough time to avoid an injury event (Langham et al., 2003). Relatively more pedestrian accidents occur at night than at any other time of day, when controlling for public road exposure and vehicle flow (Goodwin & Hutchinson, 1977). Increasing pedestrian conspicuity to enable vehicle drivers to see them is one important method for increasing public road safety (Allen et al., 2000; Greatrix & Smithies, 1999; Lesley, 1995).

Reflective material has been found to increase pedestrian conspicuity, specifically fluorescent material during daytime and reflective material at

night or in inclement weather when vehicle headlights are in use (Kwan & Mapstone, 2003). Two types of reflective material are cited in the literature. Non-retroreflective material tends to reflect light in directions which may be different than the original source of the light (Cassidy et al., 2005). Retroreflective material, a more recent development, reflects light back in the direction of the light source, e.g., the oncoming vehicle driver, thus making pedestrian conspicuity brighter and more visible at night than with non-retroreflective material (Cassidy et al., 2005). In this report, the general term "reflective" material will be used since prior studies involved both retroreflective and non-retroreflective material.

Beith, Sanders, and Peay (1982) showed that reflective material placed on clothing increased detection accuracy compared to clothing with no or minimally reflective material. Harrell (1993, 1994) showed that pedestrians wearing highly conspicuous clothing were more likely to cause drivers to stop in marked crosswalks than when pedestrians were wearing less conspicuous clothing. This increase in detection accuracy at a greater distance allows the machine or vehicle operator more time to avoid hitting a worker or pedestrian and thus would likely contribute to accident rate reductions (Beith et al., 1982).

Reflective material can currently be found on some clothing and footwear. However, consumers' perception of its value has not been adequately addressed in the research literature. The addition of reflective material would most likely increase the selling price of the garment or footwear to cover the increased production cost. The concern is that consumers may not be willing to pay even a small amount more for items with reflective material, or may even want to pay less.

Costello and Wogalter (2004) showed that a relatively large segment of the population is interested in and willing to spend more for reflective material on athletic shoes (60% of respondents), sweatshirts and jackets (49% of respondents). The present study poses a somewhat different question in that it asks participants how much *more or less* they would be willing to pay for clothing items with reflective material added to them.

Attentional conspicuity, i.e. an object's ability to be detected and responded to expediently, is affected by its size, contrast with the background, and physical properties (Allen, 2000; Hughes and Cole, 1986). Studies have shown that reflective materials arranged in a "biomotion" configuration enhance object recognition (Allen, 2000; Kwan et al., 2006) versus the amount of reflective trim used or its intensity (Sayer and Mefford, 2004). The present study examines a much larger variety of clothing items than prior studies. In particular, it includes items that would potentially enhance "biomotion" related conspicuity such as gloves, helmets, headbands and shoes.

## METHOD

A total of 184 volunteers from a small metropolitan community in the Mid-Atlantic region of the U.S. participated. Overall mean age was 32 (SD = 15.2 years; ranging from 18 to 81 years old). Approximately 54 percent were non-students employed in a variety of occupations or retired. Forty-five percent were college students, majoring in various subject areas. Forty-six percent of participants were male.

Participants were asked to report how many days they walked, ran, jogged and/or rode a bicycle in the dark in the past year. They were then provided with a list of clothing items shown in **Table 1**. The order of the items was randomized. Approximately one half saw the randomized order and the other half saw the reverse order. Participants were asked to examine the entire list of clothing items before indicating in the blanks next to each clothing item the following:

- (a) an estimated price for the clothing item *without* reflective material;
- (b) how much *more or less* money they would be willing to pay for the same clothing item *with* reflective material.

Respondents gave answers in dollars and cents. Before responding, they were given the following scenario:

Suppose you were considering purchasing one of two identical clothing items. The only difference is that one of them has a small amount of reflective material added (like the reflective trim found on some athletic shoes) that does not reduce the attractiveness of the clothing item.

An example was also given to participants:

Suppose you estimate the price for an item *without* reflective material to be \$30. You would write this amount in the first blank next to that item. If you would be willing to pay \$3 more for the item *with* reflective material, then you would write +\$3 in the second blank space. If you prefer to pay no additional money, put a 0 in the blank space. If you would pay less for the item *with* reflective, such as \$3 less, then put a *minus dollar amount* in the blank (−\$3).

After completing the questionnaire, participants were debriefed and thanked.

## RESULTS

**Table 1** shows the mean responses (and standard deviations) for (a) the estimated cost for clothing without reflective material, and (b) willingness to pay less or more for clothing with reflective material. A new variable was produced from the

**Table 1. Mean estimated price of clothing items without reflective material, % willingness to pay more for reflective material, and mean dollar amount more or less for added reflective material. (Standard deviations in parentheses, n = 184).**

<i>Clothing item</i>	<i>Mean \$ price without reflective material</i>	<i>(SD)</i>	<i>% willing to pay more for reflective material</i>	<i>Mean \$ amount more or less would pay for reflective material</i>	<i>(SD)</i>
athletic shoes	60.27	(18.3)	69.0	\$3.86	(6.3)
dress shoes	56.61	(28.4)	14.1	-\$2.60	(1.7)
jacket	48.91	(33.5)	63.1	\$3.15	(5.4)
raincoat	36.35	(22.3)	70.0	\$3.18	(4.6)
umbrella	13.21	(9.9)	44.6	\$1.05	(3.0)
socks	5.33	(3.3)	24.0	\$0.25	(1.9)
helmet	35.90	(29.5)	80.4	\$6.10	(7.2)
sport uniform	41.45	(23.5)	54.9	\$3.79	(6.3)
sweat band	6.10	(4.3)	38.6	\$0.70	(1.4)
leg/arm band	6.63	(5.2)	45.1	\$1.00	(2.2)
gloves	12.25	(7.3)	33.2	\$0.75	(2.2)
shorts/pants	25.95	(11.7)	47.3	\$1.33	(4.3)
children's clothes	22.88	(12.7)	74.5	\$4.82	(6.4)

data which indicates the percentage (%) of people willing to pay more (i.e., greater than \$0). Results are shown in the middle column of **Table 1**. General findings are presented then gender response differences are addressed. No significant age differences regarding reflective clothing preferences were found.

Findings indicate participants were willing to pay *more* for reflective material to varying degrees for all clothing items listed, except for dress shoes, for which they would pay less. Three product categories showed high desirability for reflective material: sports-related clothing, children's clothing, and inclement weather clothing.

Sports-related clothing items (e.g., helmet, athletic shoes, sports uniforms) received among the highest scores in terms of percentage of persons willing to pay more for articles with reflective material. Eighty percent of respondents were willing to pay more for a helmet with reflective material ( $M = \$6.10$ ,  $SD = 7.2$ ). Sixty-nine percent were willing to pay more for athletic shoes ( $M = \$3.86$ ,  $SD = 6.3$ ). Approximately 55 percent of respondents were willing to pay more for sport uniforms ( $M = \$3.79$ ,  $SD = 6.3$ ). More than 74 percent of respondents were willing to pay more for

children's clothing with reflective material ( $M = \$4.82$ ,  $SD = 6.4$ ).

Participants were also willing to pay more for items used in inclement weather: 63% for jackets ( $M = \$3.15$ ,  $SD = 5.4$ ), 70% for raincoats ( $M = \$3.18$ ,  $SD = 4.6$ ), and 45% for umbrellas ( $M = \$1.05$ ,  $SD = 3.0$ ).

Clothing items such as dress shoes, socks, sweat/leg/arm bands and gloves were reported less frequently as items individuals would pay more for with reflective material. Very few respondents (14%) were willing to pay more for reflective trim on dress shoes. Eighty-six percent of participants wanted to pay *less* for dress shoes with reflective trim than for ones *without* reflective trim ( $M = -\$2.60$ ,  $SD = 1.7$ ).

Participants reported spending an average of 38.9 days ( $SD = 71$ ) in the prior year outdoors walking, jogging and/or bicycling *in the dark*. Participants spending less time outdoors in the dark tended to be older than those spending more time outdoors in the dark ( $M = 34$  years versus  $M = 29$  years, respectively;  $t(182) = 1.98$ ,  $p < .05$ ).

Participants who spent more time outdoors in the dark (88%,  $n = 58$ ) were more willing to pay more for children's clothing with reflective material

(Mantel-Haenzel  $X^2$  [1,  $n = 184$ ] = 4.24,  $p < .05$ ) than participants who spent less time outdoors in the dark (68%,  $n = 126$ ).

There were no significant gender differences regarding the amount of time participants spent outdoors in the dark. However, there were several notable gender differences with regard to reflective material desirability. Female participants (76%,  $n = 100$ ) were willing to spend more for athletic shoes with reflective material (Mantel-Haenzel  $X^2$  [1,  $n = 184$ ] = 4.96,  $p < .05$ ) than males (60%,  $n = 84$ ). Female participants were also willing to pay more than men for jackets (70% of women vs. 55% of men, Mantel-Haenzel  $X^2$  [1,  $n = 184$ ] = 4.52,  $p < .05$ ) and helmets (89% of women vs. 70% of men, Mantel-Haenzel  $X^2$  [1,  $n = 184$ ] = 10.16,  $p < .001$ ) with reflective material.

## DISCUSSION

Not only are clothing items with reflective trim beneficial for people who spend time outdoors in the dark, findings suggest people want reflective material and are willing to pay more for it.

The results suggest people may have a stronger willingness to pay more for some clothing items with reflective material than others. Participants were willing to pay more for sports-related clothing items such as helmets, athletic shoes, and sport uniforms. Clothing items worn in inclement weather when conspicuity is especially challenging also appear desirable at a higher price, e.g., jackets, raincoats, and umbrellas.

Surprisingly, participants showed limited interest in reflective trim for gloves, socks and sweat/leg/arm bands, which are potentially good sites for producing “biomotion” related conspicuity. Cassidy et al. (2005) showed that trim garments are detected and recognized at greater distances than area-reflective garments. In addition, research by Beith et al. (1982), Greatrix and Smithies (1999) and Sayer et al. (2004) suggests that “biomotion” placement and configuration play a significant role in enhancing conspicuity. These study findings suggest consumers may not understand the role “biomotion” related conspicuity plays in pedestrian accident prevention and how to effectively use clothing items such as gloves, socks or armbands to

make themselves more visible at night and in inclement weather. Human factors/ergonomic research could help clarify consumers’ understanding of “biomotion” related conspicuity and how to best develop and market appropriate reflective clothing items to enhance it. In addition, consumers may not be aware of the differences in conspicuity offered by different types of reflective material, e.g., retroreflective versus non-retroreflective. Again, HF/E research could help determine the best approach to take in educating consumers regarding appropriate reflective material placement as well as clothing options.

These findings suggest people are interested in purchasing clothing items that could increase their safety. Although reflective material can sometimes be found on running shoes and some kinds of athletic wear, other kinds of clothing with reflective material are less commonly available. These data showing that people desire reflective trim on certain types of clothing may encourage manufacturers to make items with reflective material more broadly available.

Based on study findings, a prediction could be made regarding other garments or accessories that might be preferred with reflective material, such as, boots/galoshes, knee braces, crutches, rain or hard hats, infant strollers/carriers, and baseball mitts. Just as the negative interest for reflective trim on dress shoes, the prediction can be made that highly aesthetic clothing would garner negative support, for example, various types of formal women's and men's wear.

Findings suggest women may be an important target group for clothing featuring reflective material. While women were equally likely to spend time outdoors in the dark as men, they were more likely to pay extra for certain items featuring reflective material than were men, specifically, athletic shoes, jackets and helmets. Women, who spend time outdoors in the dark, have the dual and often conflicting challenge of staying visible enough to avoid being hit by a motor vehicle, yet inconspicuous enough to avoid attracting the attention of potential predators. HF/E research would be helpful in addressing this potentially conflicting safety issue.

Participants who spent more time outdoors at night, regardless of gender, were willing to pay more for children's clothing with reflective material. Children are an "at risk" group for pedestrian motor vehicle accidents and fatalities (NHTSA, 2005). HF/E research could play an instrumental role in addressing this important safety issue.

These findings suggest that individuals recognize and value the safety benefits of clothing items with reflective material. HF/E can contribute to those safety benefits with additional research, product design and interventions focused on how to most effectively incorporate reflective material into clothing and other items. HF/E input could help determine how to best maximize conspicuity at the proper times and appropriately minimize it at other times. Thus, safety, aesthetics and profitability could be successfully married. In addition, HF/E can assist in communicating hazard information and the safety benefits of reflective trim.

The present results raise additional questions and identify market opportunities to be explored and addressed with future HF/E research, perhaps in collaboration with clothing manufacturers, buyers, reflective material manufacturers, and allied safety groups. HF/E research could continue to make valuable contributions to this area of safety research.

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