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NOTES

Do Children Have One Third Less Peripheral Vision Than Adults?

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The following report is a case study example of how problematic information can invade and percolate through the literature on forensic human factors and ergonomics. Initially, a highly doubtful assertion was used to bolster an argument made in a legal case of wrongful death. The assertion was supported through reference to a number of cited works. When the trail of evidence was pursued, however, it became clear that diverse citations had all branched from one, single, original and doubtful source. The fundamental issue, whether children have one third less peripheral vision than adults turns out to be much more complex than the original, simplistic spatial conception suggested. The case study illustrates the importance of ascertaining original citations and is yet another example of the frustration that often accompanies forensic activity where financial and legal concerns frequently over-ride the fundamental search for knowledge.

case study evidentiary basis adult-child peripheral vision

1. INTRODUCTION

Safety, ergonomics and human factors are areas of crucial interest to the legal profession who find themselves often faced with critical questions about human motivation and behavior. Many cases revolve around understanding the goals, actions and performance errors of the respective individuals involved. Often, such actions are couched in a technological context in which the behavior of interest involves interaction with some object or tool, or more generally a technical system. At this juncture, the respective interlocutors call upon experts in the arena of human behavior and more and more on those with expertise in safety and ergonomics. It is perhaps at this juncture that our science is faced with its greatest challenge. It is critical that we meet and conquer such daily challenges in courtrooms all across the globe and rebuff those who fail to understand and appreciate the content and the value of our science. For example, recent arguments in the USA over ergonomics regulation by the Occupational Safety and Health Administration (OSHA) have found a Congressional representative referring to ergonomics as "voodoo science". Consequently, as well as generating content-domain knowledge, it is important we defend the validity and veracity of that knowledge by challenging unfounded or uncertain assertions made in many theaters of activity, but especially the courtroom. The purpose of this case study is to illustrate that process using a specific example.

2. A PUZZLING ASSERTION

During involvement in a recent wrongful death case I encountered and was asked to evaluate an assertion made by a safety and human factors expert that children possess one third less peripheral vision than adults. I was at the time and remain skeptical of this proposition. Indeed, from the statement itself, it was unclear whether this differential capacity was purported to be a function of limited sensory capability (a lesser capacity of the eye itself), a function of limited

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attention (suggesting differential central processing capacities), or whether the problem was conceived as a limitation to both in combination, a matter to which we shall return. Being doubtful of this difference in the first place, I followed up on evidentiary basis that had been provided. In this specific case, the observation was supported through citation to Eubanks and Hill's text [1]. There it was reported on page 339 that a 1996 report by Goertz had stated this conclusion. The initial problem of a 1994 text referring to a 1996 report was resolved when it became clear that the reference should actually have been made to the second edition (see [1]). Thus, despite the initial problem of inconsistency with dates, the original citation was appropriate and the remaining question was where Eubanks and Hill had obtained this information. Fortunately, they also provided citations to support this assertion and the next step was to consider the actual content of that citation in more detail.

Upon obtaining a copy of Eubanks and Hill [1], the relevant passage on page 339 stated:

> Children do not process what they see and hear as well as do adults. Healthy adults process inputs much faster than children; children receive normal sensory inputs, but, owing to their short exposure to such sensory stimulants, they are unable to process the information as effectively as adults. Their lack of experience causes perceptual difficulties resulting in uncertain reactions when confronted with traffic. [96] A 1996 Report by Goertz, stated that children have 1/3 narrower peripheral vision than an adult. [97] Children have trouble judging the speed and distances of approaching vehicles and some very young children cannot differentiate between moving and stopped or parked vehicles. [98]

Notice here that Eubanks and Hill [1] appear to be saying that there is no difference in pure sensory capacity, "children receive normal sensory inputs", but that the subsequent problems emerge because of experience (although precisely how such experience facilitates speed of processing is not explained). Such statements appear very authoritative. However, the true utility of this passage lies in the fact that there are further citations to other evidence. The presence of such citations is critical since it allows us to pursue the trail of evidence. The citation given in their footnote [97], reads:

> Debbie Goertz, Driveline Texas Traffic Safety News and Information, Summer 1996. Additional support for the 1/3 less vision, University of North Carolina Highway Safety Research Center, 'Florida Pedestrian Planning and Design Guidelines.' Prepared for Florida DOT, May 1996. This is supported by the AAA Traffic Foundation.

Their second citation, [98], which from the original text appears to refer to children's inability to differentiate between moving and stationary vehicles, actually refers back to the issue of peripheral vision and reads:

> Additional support for the 1/3 less vision. University of NORTH Carolina Highway Safety Research Center, 'Florida Pedestrian Planning and Design Guidelines,' Prepared for Florida DOT, May, 1996.

The immediate implication of these multiple citations is that there were three separate sources which each confirm the diminution of children's peripheral visual capability, published by three independent research groups. If this were indeed the case, this would represent significant and converging evidence in support of the purported difference. Unfortunately when we delve deeper into these individual citations, we find that this is not so.

3. ON THE TRAIL OF THE EVIDENCE

The first step in the sequence was to gather all of these references together. Having obtained these, it

was very obvious that none of the sources were basic, experimental research. Rather, they were each secondary reports designed largely for safety professionals and public usage. The reference to Goertz (1996) is illustrative. First, the citation is not complete, the article is actually by Debbi (not Debbie) Goertz together with a co-author Bill Cloyd of TEEX, of the Texas A&M System. This may seem pedantic in commentary but it is a series of these sorts of failings that sum to the whole problem. It is critical to note first that this article is *not* a report of an empirical experiment published in a peer-reviewed journal. Rather, it is an overview of Back to School Safety in a general safety publication, Driveline, being a Texas Traffic Safety News and Information source. It should be understood that this is not a comment on the intrinsic quality or value of this work. Indeed, such sources are crucial to the dissemination of all safety and ergonomics knowledge. But, it remains vital to understand that the observation concerning children's differential capabilities in Goertz and Cloyd (1996) does not come from their own original research. Thus the citation by Eubanks and Hill [1] is, at this juncture, to a secondary source. In contact with the second author—Bill Cloyd—in 1999, he indicated that reference to the original observation came from an American Automobile Association's (AAA) Foundation video entitled Children in Traffic. Debbi Goertz subsequently confirmed this (personal communication, 1999) and suggested that a German video also had helped in the formulation of their article. Given that the AAA video also provides only general information and does not reference direct experimental finings, the actual reference by Eubanks and Hill is to, at best, a tertiary source.

In their footnotes, Eubanks and Hill [1] indicate that "additional support" came from a number of other sources and the implication of this is that there is further independent confirmation of the assertion about children's peripheral vision. One such source is the University of North Carolina Highway Safety Research Center Contract Report to the Florida Department of Transportation (DOT) [2]. The relevant section in the April 1999 version of this document[1] comes under Chapter 3 "Human Factors and the Pedestrian" (pp. 17–27) and begins on page 24 under the section heading Pedestrian Capacities. In section 1, on young children, the bulleted notation reads:

> Limited peripheral vision, sound source not located easily.

Again, the crucial point is that the North Carolina Report to the Florida DOT is *not* a report of original experimentation since no original peer-reviewed research is given in this chapter of the document. Indeed, given its very nature, it is extremely doubtful that original experimentation was ever the aim or goal of this overall advisory document. Therefore, reference by Eubanks and Hill [1] to this document as though it provided direct, empirical confirmation is misleading. In the North Carolina Report, they do cite their base reference materials and in the relevant chapter, the citations appear on page 27. The reference to children's capacities comes under reference 5, which reads:

> Sandels, Stina "Children in Traffic," Paul Elek, London, 1975; and AAA Safety Foundation Video by same title.

4. THE SINGLE SOURCE LOCATION

Given these collective observations, when we examine in detail the references made by Eubanks and Hill [1], we find that the Goertz (and Cloyd) reference emanates from the AAA video. Further, the North Carolina Report is also founded on the AAA video and the final source cited by Eubanks and Hill is indeed the AAA video itself. What had appeared to be independent confirmation from three different sources, which ostensibly had evaluated the phenomenon of children's vision, now

[1] I have been unable to locate any previous version of this report.

represented three general safety references each citing the same source. Clearly, the next step was to secure a copy of the AAA video, Children in Traffic, which was quickly accomplished[2].

The AAA video provides a general overview of child safety in relation to traffic. However, the most interesting component for the present argument comes in terms of the visual representation, a schematic of which has been redrawn and shown in Figure 1. As is evident from this figure, the implication is that there is a direct "spatial" reduction of the visual field by some "supposed" one third and that such a reduction occurs in the peripheral field of view. This means that the citation by Goertz is correct but even at this stage, it is not possible to distinguish whether the child's disadvantage is sensory or attentional in nature.

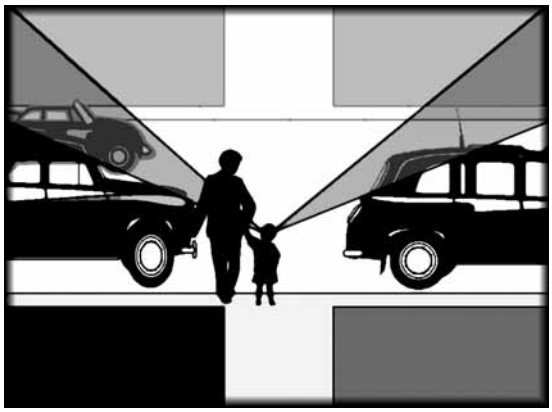

Figure 1. A schematic representation of the child's reduced visual capacities. In previous expressions of this issue, the restriction has only been illustrated as a limitation in the single, horizontal axis. Of course, the assertion pertains to the whole visual field. This being so, a reduction of 1/6 either side would result in 36% reduction of the whole visual field. If the 1/3 notion is supposed to be for each side of each eye, the child would experience a 78% restriction with respect to the visual field of the normal adult. Clearly, these simple geometric calculations do not involve the overlap of the visual field of the two eyes. However, it provides a more startling numerical calculation of the supposed restriction involved here.

5. THE PRECISE NATURE OF THE CLAIM

The major thrust of the present work is that one should not take counter-intuitive, or even intuitive assertions at face value. As Chapanis was recorded as replying to someone who commented that human factors and ergonomics was merely common-sense, it is distinguishing the 10% which was not common sense which is the challenge. The whole issue of the unsatisfactory citation is both problematic and tragic in that even a simple on-line search renders enormous amounts of information on this topic well beyond the original text of Eubanks and Hill (see [3, 4, 5, 6, 7, 8, 9, 10, 11, 12]). Interestingly, while the evidence for a reduction in children's sensory capabilities, compared to adults, is poor and questionable, the issue of attentional differences is an important one and remains to be clarified to a satisfactory extent. The present work does not seek to resolve this issue since the particular content area is only illustrative. However, the interested reader is certainly encouraged to pursue this identified concern further and hopefully provide that necessary resolution.

6. NOT A SATISFACTORY CONCLUSION

One of the great frustrations of the forensic aspect of ergonomic and safety work is the lack of fundamental concern with the questions on behalf of the legal community. Many readers will have had experience with this but perhaps a brief exposition might be helpful. At least in the USA, the litigation procedure is pursued with great energy and acumen. In general, lawyers are extremely bright individuals who are able to assimilate vast quantities of technical information and subsequently pose pointed and insightful questions. However, once the case is concluded, they immediately pass on to the next one. Questions which at one moment are vital to resolve,

2 Whether the AAA video is the same as the Sandels/Elek video at present remains uncertain.

following the settlement of the case, become completely superfluous to the litigator and the expert witness is left with an extreme sense of frustration and incompleteness as the process passes on to other concerns.

The present account represented one of these events. The wrongful death case was settled and the issue of differential capacities of children in terms of sensory abilities or attentional capacities immediately became moot as far as those in the process were concerned. The present author was unable to find either of the English or German videos which purported to be the source of the AAA presentation and so the original research experimentation which, presumably, underlay those productions remains unidentified. In a financially driven legal system, there is no stimulus to complete any such search and other than communications such as the present one, the whole process goes largely unrecorded, even though this is a crucial arena in which professionals in safety and ergonomics exert an important societal impact. Three points can be made in conclusion. First, some diligent reader hopefully, might further pursue the trail to provide resolution on the content issue of differential children's capacities. Second, the case study illustrates the importance of questioning the basis for even so-called expert's assertions about human behavior since it is especially important that we self-monitor our science very carefully given the attacks that have been made by those with a political agenda to pursue. Finally, it is hoped the present work will stimulate a discussion concerning our role in forensic and litigation activities and to promote our own efforts to find better was of integrating our knowledge with the legal process.

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