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Review article

A Review of Hazard Anticipation Training Programs for Young Drivers

Catherine C. McDonald, Ph.D., R.N. [a,b,c,*], Arthur H. Goodwin, M.A. [d], Anuj K. Pradhan, Ph.D. [e], Matthew R. E. Romoser, Ph.D. [f], and Allan F. Williams, Ph.D. [g]

[a] *Department of Family and Community Health, University of Pennsylvania School of Nursing, Philadelphia, Pennsylvania*
[b] *Department of Pediatrics, Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania*
[c] *Center for Injury Research and Prevention, The Children's Hospital of Philadelphia, Philadelphia, Pennsylvania*
[d] *Highway Safety Research Center, University of North Carolina, Chapel Hill, North Carolina*
[e] *University of Michigan Transportation Research Institute, Ann Arbor, Michigan*
[f] *Department of Industrial Engineering & Engineering Management, Western New England University, Springfield, Massachusetts*
[g] *Allan F. Williams, LLC, Bethesda, Maryland*

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A B S T R A C T

Purpose: Poor hazard anticipation skills are a risk factor associated with high motor vehicle crash rates of young drivers. A number of programs have been developed to improve these skills. The purpose of this review was to assess the empirical literature on hazard anticipation training for young drivers.
Methods: Studies were included if they (1) included an assessment of hazard anticipation training outcomes; (2) were published between January 1, 1980 and December 31, 2013 in an English language peer-reviewed journal or conference proceeding; and (3) included at least one group that uniquely comprised a cohort of participants aged <21 years. Nineteen studies met inclusion criteria.
Results: Studies used a variety of training methods including interactive computer programs, videos, simulation, commentary driving, or a combination of approaches. Training effects were predominantly measured through computer-based testing and driving simulation with eye tracking. Four studies included an on-road evaluation. Most studies evaluated short-term outcomes (immediate or few days). In all studies, young drivers showed improvement in selected hazard anticipation outcomes but none investigated crash effects.
Conclusions: Although there is promise in existing programs, future research should include long-term follow-up, evaluate crash outcomes, and assess the optimal timing of hazard anticipation training taking into account the age and experience level of young drivers.

IMPLICATIONS AND CONTRIBUTION

A number of hazard anticipation training programs have been developed for young drivers. This review indicates that many of these programs have demonstrated improvements in selected hazard anticipation outcomes, predominately measured immediately after training. More research is needed to determine effectiveness on long-term outcomes, crashes, and optimal timing of program delivery.

Young driver crash risk increases markedly once independent driving begins, followed by a rapid decline over the first 6–12 months of driving [1–3]. The mechanisms that influence the decline in young driver crash involvement are not fully understood. Although maturation and increasing self-regulation occurs during the first year of driving [4], the pattern of decreasing crash risk bears a striking resemblance to the standard learning curve that describes the improvement over time in performance of complex cognitive tasks [1].

Conflicts of Interest: Two authors (A.K.P. and M.R.E.R.) were involved in the development and/or evaluation of one of the training programs described in this review.
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* Address correspondence to: Catherine C. McDonald, Ph.D., R.N., University of Pennsylvania School of Nursing, 418 Curie Blvd, Room 414, Philadelphia, PA 19104-4217.
E-mail address: mcdonalc@nursing.upenn.edu (C.C. McDonald).

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Hazard anticipation errors are common in crashes among adolescent drivers [5–8]. Various terms have been used in the literature to describe this aspect of driving behavior: hazard perception, recognition, awareness, anticipation, skills, and so forth. Given a lack of standard terminology, we have chosen "hazard anticipation" for this review to represent the broad number of terms used in the literature depicting the multiple components related to constructs of cognitive awareness, visual perception, and experiential and schema-based recognition. Hazard anticipation, thus, can be defined as a set of driver behaviors that include the following: (1) awareness and knowledge of roadway risks and associated threats to driving safety; (2) visual search that facilitates detection and recognition of elements directly or indirectly contributing to unsafe situations; (3) prediction of emerging and latent hazards based on information from the visual scene; and (4) execution of driving responses to avoid or minimize potential conflicts due to recognized hazards [9–11]. Studies indicate that young novice drivers, when compared with experienced adult drivers, have poorer hazard anticipation skills with respect to proficiency, speed, and identification of hazards that are not clearly visible to a driver until the last moment [12–15]. Improvement in hazard anticipation skills is a likely contributor to crash reductions over the first few years of licensure.

A number of hazard anticipation training programs have been developed for young drivers, with the goal of accelerating the learning process in a safe environment. Some teach drivers to predict or identify critical regions of the roadway with potential or hidden risks and to generalize these to a broader set of real-world situations [15,16]. Others attempt to improve hazard anticipation by virtually exposing young drivers to traffic hazards they might not yet have encountered in the real-world with just a few months of driving [9,10]. Some provide feedback on performance [17,18]. Given recent increases in the number and variety of programs—and recognition of the importance of hazard anticipation skills for young drivers—the purpose of this review was to assess the empirical literature on hazard anticipation training programs for young drivers.

Methods

Studies that described training in hazard anticipation, perception, awareness, recognition, or similar terminology for young drivers were included in the review if they met the following criteria: (1) included an assessment of safety-related outcomes of a hazard anticipation training program; (2) published between January 1, 1980 and December 31, 2013 in an English language peer-reviewed journal or conference proceeding; and (3) included at least one group that uniquely comprised a cohort of study participants aged <21 years. This age range was chosen because of the international variation in licensure age.

An experienced library information specialist conducted a comprehensive literature search using the following Boolean search string: ("hazard anticipation" OR "hazard perception" OR "hazard recognition" OR "risk recognition" OR "risk perception" OR "anticipation training") AND (teen* OR you* OR novice* OR adolescent*). The following databases were included in the literature search: Transportation Research Information Database, PubMed, ISI Web of Science, PsycInfo, Psychological Abstracts, and ScienceDirect.

The initial keyword literature search yielded 201 unique studies. Each study was examined in two stages by two members of the research team for inclusion, first based on title and abstract, then on full paper review. Disagreements were resolved based on consensus of two reviewers. A number of studies did not provide an age range of the sample; however, studies were included if the reported mean age of study participants was <21 years. Eighteen studies met inclusion criteria in the initial search. After review of personal reference collections and suggestions from peer reviewers, one additional study was identified that met inclusion criteria, bringing the total number of studies included in the review to 19. Table 1 summarizes the study design, number of training and comparison groups, sample, driving experience, training method, timing of the evaluation, and main outcome measures of these 19 studies. The following section briefly describes each study's training program, evaluation, and main results.

Results

Of the 19 studies, 11 used an interactive computer-based approach for training [9,10,13,15,16,19–24], five used videos [12,17,18,25,26], two conducted training in a driving simulator [27,28], and one used a combination of training methods [29]. Note, all drivers (e.g., trained group, untrained, etc.) are young drivers unless otherwise noted (e.g., "experienced" driver group).

Interactive computer-based approach

Act and Anticipate Hazard Perception Training (AAHPT). A computer-based training program, AAHPT exposes young newly licensed drivers with basic vehicle handling skills to hazards they may not have encountered, with the goal of enhancing ability to anticipate these types of hazards [9,10]. Three intervention modes were tested: active, instructional, and hybrid. During "active" training, drivers viewed short scenes of real-life driving situations and were required to press a button when they detected a hazard (no feedback about the response was provided). In "instructional" training, participants had a tutorial that included both written material and video-based examples regarding hazard anticipation and they were not required to respond to hazards. "Hybrid" training used a combination of active and instructional approaches [10].

Borowsky et al. [9] and Meir et al. [10] evaluated the effects of the three different modes 1 week after training. The study also included a group of untrained young and untrained experienced drivers. Evaluation involved a hazard perception test of 58 movie clips (button pressing for hazard detection) with three traffic environments (residential, metropolitan, and inner city) with five categories of hazards: pedestrian behavior, obstacles on road, approaching an intersection, other vehicle behavior, and limited field of view. An eye tracker was used to detect scanning patterns during the hazard perception test. Although a large number of environments and categories were examined, improvements were found on only a few selected measures. For example, hybrid and instructional trained groups reported significantly more potential hazards involving pedestrians in residential areas than experienced or untrained young drivers [10]. Similarly, Borowsky et al. [9] found that the hybrid and instructional groups were more sensitive to the presence of pedestrians than the other groups; in addition, they concluded that experienced drivers scanned for shorter periods of time (i.e., were more efficient with their scanning).