prescribed by the CPSA or the Federal Hazardous Substances Act ("FHSA").

In March 1994, Snell established the N-94 Standard For Protective Headgear For Use in Non-Motorized Sports. This standard provides greater head coverage than current bicycle helmet standards, tests for multiple impacts at a single location on the helmet, and tests to see if the helmet will roll off on impact. However, the Commission lacks data that multiple impacts at a single location are a factor in injuries to persons wearing bicycle helmets or that greater helmet coverage is needed for bicycle accidents. Furthermore, the use of an additional anvil in the Snell N-94 test may preclude the use of some current vent designs used in bicycle helmets. The Commission is aware of only a few helmets currently on the market that are certified to this standard.

Activities like roller skating, in-line skating, and skateboarding are typically conducted on the same types of surfaces as bicycling and can generate speeds similar to bicycling. In addition, these other activities do not put the user at a higher height than when using a bicycle. Thus, fall heights can be expected to be similar. It is reasonable to assume that the test requirements in the bicycle helmet regulation would allow the helmet to provide some protection for other activities—such as in-line skating, roller skating and skateboarding—until multiple-activity helmets become widely available. However, the Commission does not have sufficient data on the benefits and costs of additional features directed at injuries incurred other than bicycling to make the findings that would be required by either the CPSA or FHSA. Also, procedures in addition to those required by the Bicycle Helmet Safety Act would have to be followed. The Commission does not want to delay establishment of a mandatory bicycle helmet standard in order to pursue rulemaking for other types of helmets. Accordingly, this proposed regulation only addresses bicycle helmets.

Comment: General construction provisions. Section 1203.5 of the originally proposed mandatory standard included several provisions that addressed general construction characteristics of a bicycle helmet. These provisions specified that helmets shall be designed to reduce the acceleration forces imparted to the wearer's head by an impact and to remain on the wearer's head during impact. It was also specified that helmets shall be constructed not to be harmful or potentially injurious to the wearer. For example, the original proposal stated that the helmet surface shall not have projections that may increase the likelihood of injury to the rider during an accident. In addition, the original proposal provided that construction materials should be resistant to environmental conditions that may be reasonably expected during helmet use and storage and shall not be harmful to the wearer.

Some commenters on the proposed rule stated that many of the requirements in § 1203.5 are subjective, since they have no performance-related criteria. One respondent suggested that these sections be located in an informative annex rather than in the body of the standard.

Response: Sections 1203.5(a) and (d) of the original proposal—titled "General" and "Materials," respectively—contained no objective performance criteria to establish compliance. Section 1203.5(c)— "Retention System"—was redundant since it merely referenced test requirements elsewhere in the standard. Accordingly, the Commission is eliminating these paragraphs from the revised proposal.

The first proposed standard required that external projections must "readily break away" and internal projections shall be protected by "some means of cushioning." In response to the comments that this language was subjective, the Commission is revising the language to define more objective performance criteria. The revised requirement is that the helmet be examined after impact testing to determine whether there are any rigid internal projections that could contact the wearer's head.

Comment: Children's peak g-value. Some comments recommended that the peak g-value for children be dropped from 300 g to 250 g or 200 g. Some commenters suggested that no change be made in the g-value.

Response: Despite the high incidence of head injury among children, studies addressing mechanisms of injury and recovery are lacking. Therefore, even though children make up the majority of the population at risk for head injury, children's helmets sold on the market today generally are designed to meet the attenuation and absorption criteria established for the adult helmetedheadform drop tests. The criteria for testing and evaluating the performance of helmets have been established primarily on the basis of data derived from injury tolerance studies conducted on adults. This is a matter of some concern, since studies indicate that the type of head injury resulting from blunt

trauma may differ significantly between adults and children.

The skull is the brain's primary protection against blunt force trauma. The properties of the skull change significantly as a child matures. Cranial capacity reaches adult size by 5 years of age. At 18 months, the brain has attained almost 70% of its adult size and, by 5–8 years, it is 90% of adult size.

Most of the head growth beyond the first 5 years involves hardening of the skull and thickening of the soft tissue around the brain. Children appear to be at greater risk of diffuse brain injury because their skulls have a lower degree of calcification, which provides a reduced capacity to absorb an impact. This results in a greater transfer of the kinetic energy from the impact site to the brain tissue.

The differences in the type of head injuries sustained by children and adults should have some bearing on helmet design. Currently, no compensation has been made for the differences between adults and children in head injury tolerance levels regarding the bending strength of the skull.

Current United States bicycle helmet voluntary standards recommend that helmets limit an attenuation impact to below 300 g in order to reduce the risk of severe injury. However, for the reasons described above, this may be inadequate to protect children. Published reports have suggested reducing the g-value for children from 300 g to 150 to 250 g.⁸

A helmet may partially compensate for the flexibility of a child's skull. However, the interior dimensions of the helmet will not perfectly fit the skull. In an accident, point contact is likely to occur between the skull and the helmet, which will tend to flex the child's skull more than an adult's. Accordingly, the Commission concludes that a differential in the g criteria is needed between adults' and children's standards. The Commission proposes to lower the g-value to 250 g. This will provide a substantial extra margin of safety to account for the increased flexibility of children's skulls, without making the criterion so stringent that it is either not cost effective or results in helmets that are so heavy or bulky that their use would be discouraged.

⁸Corner JP, Whitney CW, O'Rourke N, and Morgan DE. Motorcycle and Bicycle Protective Helmets—Requirements. Dept. of Trans. and Comm., Federal Office of Road Safety, Australia, May 1987. Lane JC. Helmets for Child Bicyclists, Some Biomedical Considerations. Federal Dept. of Transport, Office of Road Safety, Australia, CR 47, 1986.