How to Teach an Adult to Ride a Bicycle
Planning Sequences of Instruction

A Proposed Study from the Behaviorist Perspective
For
ED 333A

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I. ABSTRACT

The acquisition of certain skills, such as learning to ride a bicycle, are considered to be in the domain of skills acquired by children. Little attention is paid to the adult learner of cycling skills. The absence of mainstream instructional learning artifacts, adult-sized training wheels for example, are evidence of the classification of cycling skills as “child’s play.”

In this paper, we discuss the development of an initial curriculum. The teaching method and the sequence of instruction used to develop the initial curriculum is based primarily on behaviorist and information-processing learning theories. This initial design was then used to conduct a short pilot study. The findings of the pilot study are examined and are used to modify the sequence and elements of instruction. And, finally the implications of our findings and how they can be used to inform a proposal for the key elements of an instructional sequence for a preliminary design of a bicycle riding computer simulation are presented.

II. THE PROPOSAL

A. BACKGROUND

Students attending large university campuses (in particular, relatively level campuses such as Stanford University) find that riding a bicycle tends to be the most convenient and economical method of transportation. Not only do they avoid the cost of maintaining a car (fuel, insurance, and general maintenance) and the associated parking fees, they also find that a bicycle will also get them physically closer to their destination in a shorter time. There exists a certain percentage of students that have not learned the cycling skills necessary to use this mode of transportation. As a consequence, these potential adult learners of cycling skills are at a distinct disadvantage. Although, building cycling skill is not one of the stated goals of the university educational system, building skills for independent learning is.

These are adults from many countries of the world who have never ridden a bicycle. They may have grown up in crowded cities where bicycles are rarely employed for transportation because of safety and logistical reasons. They may have never owned a bicycle of their own. Or they may have fallen from a bicycle before and became discouraged thereafter.

When these adults attend a university to pursue undergraduate or graduate degrees, they soon realize that bicycling is the most popular and versatile form of transportation on campus. However, because of fear of falling and the resulting injury and pain, of failure and embarrassment, and because of the initial investment of time, safety equipment and the bicycle itself for an endeavor that has no guarantee of success, many adults resort to
walking or waiting at bus stops for the campus shuttles (if provided). This may be good exercise for some, but in general, it is an inefficient and time-consuming way of traveling on campus.

B. LEARNING PROBLEM

Adult students who have never learned to ride a two-wheel bicycle are highly motivated to learn how to ride one skillfully within a short period of time to help them get around campus quickly and efficiently. There are no training programs or training artifacts to help these students build the skills necessary to use a bicycle.

C. CURRENT PRACTICE

For the few brave hearts that resolve to learn because of “necessity”, learning to ride a bicycle becomes a task of trial and error. Children often begin with training wheels to provide balance, but manufacturers don’t make training wheels for adult bicycles, presumably because there is no market for them. As a result, the few adults who learn bicycling on their own, often start out with a few minutes per day, struggling to conquer two feet of distance, then four feet and so on, while maintaining balance, pedaling and steering all at the same time. The skill of braking doesn’t come until several sessions later when the learner is able to stay on the bicycle for a longer duration of time. After some scrapes and bruises on the hands, elbows and knees, some learners eventually succeed in riding the bicycle proficiently after a few weeks in the “school of hard knocks”.

D. DEVELOPING A SEQUENCE OF INSTRUCTION

Learning how to ride a bike is a good illustration of learning hierarchies of skills. We have designed an approach to teaching adults cycling skills applying the concepts of sequenced directed instruction. An initial analysis of the prerequisite skills and the key elements needed for riding a bicycle are illustrated in the following diagram. “When such an analysis is made, the result is a kind of map of what must be learned. Within this map, alternate ‘routes’ are available for learning, some of which may be best for one learner, some for another. But the map itself must represent all of the essential landmarks; it cannot afford to omit some essential intervening capabilities.” (Gagné, R.M., 1965)
Passed initial stage
(without external aids from the

Ability to get up a bike, ride steadily for a
distance, stop and get down the bike.

On a big bike, new skills of getting the
initial momentum and stopping.

Ride the small bike with
verbal and physical help
(holding shoulders)

“Assisted”
Balancing

Conquer fear, start
with a ‘small’ bike.

Braking Pedaling Steering

Prerequisite Skills:
Ability to walk
(demonstrates balance)
Verbal recognition of
verbal commands: pedal,
look forward, balance, etc.

Figure 1: The learning hierarchy of learning how to ride a bike
Modeling the conceptual framework.

When learning procedural knowledge where the activities are organized to optimize acquisition of information and routine skill, according to behaviorist principles, learning occurs most effectively if the teaching or learning program is well organized, with routines for activity that students know and follow efficiently (Greeno, J., et. al., 1996).

In suggesting a model, we have followed these concepts in designing a curriculum. Each learning lesson is well organized with explicit instructional goals, to ensure that students have learned prerequisite skills for each new component introduced. Each step provides opportunities for students to respond correctly, and correspondingly the instructor gives detailed feedback to inform the students which items they have learned and which they still need to work on. Additionally, opportunities to provide reinforcement for learning that satisfies students’ motivations are also built in (Greeno, J., et. al., 1996).

The first issue to address will be the fear factor. This involuntary response that is associated with fear of injury and pain may hinder the learning process. To provide for safety and more secure feelings, the student will put on her wrist supports, elbow and kneepads and helmet. This should provide a level of confidence that if, you were to fall, lasting physical injury would not occur. Bodily parts that could get injured would be protected.

The key component for learning to ride is balancing. As stated by the behaviorist, in order to facilitate learning of a complex but well-defined skill, the sequence of instruction should proceed from simpler components to the more complex component that they compose (Greeno et al, 1996). The first bike for the students will be a bike that is “small” enough, so that the student can sit on the saddle with both feet flat on the ground. Besides providing for additional feelings of safety (being able to touch ground), this will provide an easy-to-balance (using both feet to assist balancing) learning environment before the student is engaged in a more complex situation (on a ‘real’ bike for efficient riding).

The first lesson will entail learning how to balance on the stationary ‘small’ bike. The student will sit on the saddle, have both feet resting on the pedals and both hands on the handlebars. He/She will practice balancing on the stationary bike. The goal of this lesson is to learn the skill of “assisted” balancing which is the basic element for the following lessons. The instructor will explain the rule of how to counter-balance the leaning by making small adjustments at the handlebars. That is, if the body and the bike are leaning towards one side, the cyclist must make minor adjustments to body position and counter-balance by steering slightly in the opposite direction, being careful not to over correct and lose balance to the other side. The instructor will provide a physical demonstration together with a verbal explanation. The student will practice with the instructor holding the student’s shoulders (on and off). Constant verbal feedback will be provided “Good job!” , “To the right!”, “Not too much”, etc. When the student can remain balanced for more than 5 seconds without assistance, she will then proceed to learn the skill of “assisted balancing” on a
moving bike. This lesson is basically learning through stimulus (leaning towards one side, feeling of losing balance) – response (adjust steering towards the opposite side in order to balance) with verbal associations (follow instructions and responding/correcting according to the feedback). At the same time, the student is learning how to apply the rule of counter-balancing. This basic rule will enable the student to understand the concept of equilibrium later.

The next lesson will be learning the skill of “assisted balancing” on a moving bike. The student will be sitting on the saddle, both hands on the handlebars and instead of feet resting on the pedals, she will lift her legs up in the air. Another person will be pushing the bike forward with the instructor holding the student’s shoulders while the bike is moving. Once again, the stimulus will be the leaning towards one side (lost balance) and the response will be to steer towards the opposite in order to balance. The rule is periodically reminded by the instructor and constant feedback is given, “Try not landing your feet”, “relax at the handlebars!”, “you’re doing great!”, etc.

It is important that the instructor does not hold the handlebars. The student cannot learn the feel of balancing if the instructor is taking control of the bike. Similarly, if the instructor holds onto the saddle or any other part of the bike, the student will not necessarily realize if they are leaning a bit to one side or the other, because the instructor will be correcting for them. Instead, hold the student by the shoulders, so that as she leans to the side, she will feel the side pressure, and can learn to reduce it by turning into the lean.

When the skill of “assisted balancing” is established, the other basic skills of riding a bike will then be further broken down and taught separately. They are: (1) steering, (2) pedaling, and (3) braking. Verbal instructions as well as physical demonstration are employed repeatedly. Every time, the goal of the action is stated clearly and the concept is explained. For example, the purpose of steering is balance and change direction. Pedaling will not only enable forward motion but also to provide the momentum for balancing. The procedure is to concentrate only one component at a time. Each component will be taught and practiced on the small bike. For instance, to practice steering, student will sit on the saddle while the instructor(s) will hold the student at her shoulder and push the small bike forward by the saddle. Student will concentrate only on steering and changing direction according to the instructions (To the left! To the right! or Keep forward! Etc.). Similarly for pedaling and braking using the hand brake (instead of using feet). Basically this process involves the linking of various Stimulus-Response learning and verbal association. For example, to acquire the steering skill, she needs to comprehend and associate the verbal instruction with the skill of maneuvering the handlebars in order to turn the bike left or right accordingly. At the same time, practicing her “assisted” balancing skills.

However, as people readily forget what they have learned (Gagne, 1965), e.g. by learning how to pedal might weaken the previous skill (steering) that she has acquired. A way to reduce this interference will be to establish the learning of discrimination. Individual chains connecting each distinctive stimulus with each identifying response must be learned and measures must be taken (Gagne, 1965). The instructor will ensure that the
student has mastered each component before the next component is introduced. Then test the student repeatedly whether she can follow and carry out the verbal instruction accurately.

The next lesson will be to integrate these isolated acts that have been previously established. The task of the student will be to coordinate balancing, steering, pedaling and braking with the physical help and verbal instructions of the instructor. The instructor will hold the student by the shoulders (again) and run along behind. This should be done in a wide flat space. The instructor should not make any attempt to steer the student, just let the bike go where it will. This process is practiced repeatedly with verbal reminders (“keep pedaling!” “lean to your right”, “don’t over correct”, etc) and gradual reduce the amount of physical help (from holding onto the student’s shoulders to just pulling her sweat shirt) by the instructors. At the same time, the student will be reminded not to land both feet on the ground too often.

The student is considered to have passed the initial stage after she has finally able to coordinate the balancing, steering, pedaling, and braking on a ‘small’ bike and ride for a distance without any external aid from the instructor.

The next step will be transferring these skills to a ‘Big’ bike (where the feet can’t reach the ground now when sitting on the saddle). In order to do this, student will need to acquire two additional skills, i.e. how to get up and how to stop and get down the ‘big’ bike. The learning process of these two new skills will be very similar to the previous lessons. The instructor will explain the rule with a physical demonstration, student will follow and practice with the help from the instructor, correcting any mistakes based on the feedback from the instructor. In short, the learning process is a combination of chaining of Stimulus-response learning, verbal association and rule applying. A point to note is that the student will learn to acquire these new skills and at the same time, incorporate all the previously learned skills (balancing, steering, pedaling, braking) and concepts (equilibrium, rules of leaning).

If the student can now get up on big bike, ride steadily and is able to brake the bike and get down safely, she has graduated!

Throughout these lessons, the instructor will allow the student to learn at her natural pace, and guiding with patience. In this way, it is more likely that learning how to cycle will become a fun activity for her.

E. PILOT STUDY-HOW TO TEACH AN ADULT TO RIDE A BIKE
A highly motivated healthy test subject of the target population of learners was identified and used to investigate the skill development strategy proposed. The test subject, a 24-year-old woman, in excellent health with no physical limitations other than corrected vision was enlisted to determine whether the trial curriculum contained the key elements.

We established a learning place that was free from other forms of traffic, relatively flat, and with no obstructions to additional further barriers. A “small” bicycle in good working order was secured. Since the subject was well acquainted with the “bicycle” concept little original orientation to the physical parts of a bicycle was needed. Safety equipment was provided for the subject.

We proceeded as outlined in the trial curriculum.
1. A demonstration and explanation of balancing by the instructors was provided.
2. The subject tried the balancing exercises on a “stationary” bicycle.
3. Verbal and a physical support were provided.
4. Feedback from both subject and instructors was shared.

This first attempt revealed that the stationary bicycle idea although good on paper was not the best way to introduce balance. A certain amount of forward movement was preferable. The fear of falling and injury was very pronounced at the beginning until the subject came to trust the instructors. The subject tired more quickly than in other situations demanding stamina (fast walking or running, for example). The physical part of the lesson lasted 15 minutes with an additional 15 minutes devoted to debriefing.

A second trial was conducted the next day under very similar circumstances. The same subject, the same bicycle, the same flat surface were employed in the second trial. This time we began with the same process of explanation and demonstration by the instructor followed by the subject trying the “assisted” balancing exercise. Again, verbal and physical support was given. After a period of practice, less and less physical assistance was provided. Additionally, rather than the continual verbal focus provided by the instructors, a different subject concerning upcoming activities was begun by the instructors. The subject was not as focused on the action of balancing and so the subject was not as concentrated on the act of balancing and a slight improvement in balancing performance was noted. In the following subject-instructor exchange, the subject commented that she felt more relaxed as a consequence of the change in topic. The total lesson lasted 30 minutes. The subject was slightly more proficient at balancing.

No other trials were conducted.

**F. IMPLICATIONS**

The results of the pilot study indicate that we should make the following changes to the curriculum:
1. Establish trust with the subject. Provide a formal introduction of the process and care that the instructors will follow.
2. Change from the “stationary” bicycle concept to a “slightly forward momentum” concept when first introducing the balancing exercises. This is an easier way to achieve balance and it is closer to the way you actually ride a bicycle.
3. Keep the lessons short. Practice sessions should take into account the extra stress placed on the body. Practice sessions should focus on learning one skill at a time until the student has demonstrated an increased level of proficiency.
4. A slight loss of focus on actions can increase “natural” (direct stimulus response) learning.

These findings can help to inform an initial design of a computer bicycle simulation model. Key elements of a simulation need to address:

1. Attention to safety/fear issues. The simulation itself should remove a good deal of the fear of injury, but since the fear of falling is a basic response, care should be given to this topic.
2. A short review of the bicycle parts and names associated with those parts should be made available.
3. Provide both a verbal and a simulated physical demonstration of the concepts to be learned.
   Anderson (1976, 1982) contends that the acquisition of procedural knowledge depends on first learning prepositional knowledge (verbal information, concepts, rules and principles) and then converting that into procedural knowledge, primarily through practice. Wilson (1985) recommends the following steps in designing procedural learning:
   - Perform a path analysis to determine steps, sequence, and decisions
   - Begin with a simple example of the procedure
   - Give an overview or summary of the steps
   - Teach the principles that underlie the procedure.
4. As closely as possible the beginning practices should focus on flat surfaces, with no obstacles.
5. Verbal reinforcement should be provided at intervals.
6. Monitor the student’s progress so that “praising” and “corrective” feedback can be given as appropriate.

The research literature concerning the role of feedback in learning is extensive and ongoing. Several good summaries can be found in Dempsey and Sales (1993).
The most common function of feedback is to inform the learner about the correctness of a response. Providing reinforcement for the learner should follow correct responses. Providing correction, with the purpose of improving future performance, should follow incorrect responses. In tutorial programs, feedback should encourage the learner to improve thinking and comprehension (Schimmel, 1988)

7. Early lessons should be short.

8. Provide music in the background to provide an off topic focus.

**D. Bibliography**


