Habit and the Mathematics Classroom

Habits are a part of daily life, from the routine one follows when rising in the morning, to driving to work, to the process of typing, or checking email multiple times per day. Habits can be positive or negative and are defined in a variety of ways. A variety of patterns can help people form a habit, although changing a habit usually requires replacement of the habit with a different habit. Habits are important because they affect daily life, even though people are often unaware of habits. First, habits will be defined. Next, how habits are formed and changed will be looked at. Finally, an application for the math classroom will be given.

Habits are automated behaviors people have in response to some type of cue (Neal, Wood, and Quinn 998). Duhigg links habit with a cue, followed by a routine, which is then followed with a reward for that routine or behavior (18). Habit is the process through which an action that was previously consciously thought of becomes automated (Lally et al. 998). When an individual performs an action for the first time, conscious thought is involved (Lally et al. 998). However, as an action is repeated, it can become a habit as both speed and automaticity are increased (Lally et al. 998). Wood and Neal also describe habits as "learned dispositions to repeat past responses" (843). William James believes "All our life, so far as it has a definite form, is but a mass of habits, . ." (39). Additionally, as a person practices a behavior, that person will become more adept at the behavior and perform the behavior "more and more easily" (James 39). According to cognitivists, habits are the response shown when a stimulus is presented (Neal, Wood, and Quinn 198). "Habits are behaviors wired so deeply in our brains that we perform them automatically" (Trafton, par 1). Neal, et al. describes habits as "psychological dispositions to repeat past behavior" (par 2). Terminology can vary: James uses "impression" and "response" (40), while Duhigg uses "cue" and "routine" (19). Both agree that much of life depends on habits people form (James 39 and Duhigg 17-18). Habits can be strong, weak, or in the middle (Neal, et al. par. 2).

In terms of forming habits, context cues can arise in "direct form" and "motivated form" (Neal and Wood 844). In a study on mice, in which the mice began behind a door, and when the door was opened, the mouse could run down a small path and turn left or right (Duhigg 14-16). Towards the left there was

chocolate (Duhigg 14-16). At first, the mouse did not go quickly and spent much time sniffing and poking at the walls (Duhigg 14-16). When the mouse became familiar with the routine, the mouse would run down and turn to the left, much more quickly than it had previously wandered (Duhigg 14-16). When measuring brain activity, it was determined the mouse used less brain activity when the mouse was familiar with the routine (Duhigg 14-16). Because of the automation of the process, the mouse could perform the action much more simply. Habits can be activated by goals or cues (Neal et al. par. 3). Habits can be formed in short or long periods of time, depending on the complexity of the habit.

Often people desire to begin a habit or to eliminate a bad habit. Wood and Neal state that "people's goals can guide the formation of habit associations" (844), meaning people can consciously form their habits. Duhigg claims that new habits can be easier to form if a cue is given (34-36). In his example of someone selling Pepsodent toothpaste, advertisers used a cue of a film on people's teeth. To get rid of the film, people should brush their teeth with Pepsodent (Duhigg 34-36). This helped create the American custom of regularly brushing teeth (Duhigg 34-36).

In an experiment with monkeys, when the monkeys saw a particular shape and then pressed a lever the monkey received juice (Duhigg 44-47). Studies of the monkey's brains showed there was a spike when the monkey received the reward(Duhigg 44-47). However, as time went on, the brain spike that when with the reward of juice occurred immediately after the monkey saw the shape rather than when he received the juice (Duhigg 44-47). When the experiment was altered and the monkey with a strong habit did not receive the juice, his brain would still have the "reward" reaction, and the monkey would become unhappy (Duhigg 44-47). Monkeys with a slight habit could be distracted, whereas monkeys with a strong habit showed negative behaviors (Duhigg 44-47). In short, habits "create neurological cravings" (Duhigg 44-47). In another study on the creation of exercise habits, researchers found that while people began exercising for a variety of reasons, they continued because of the reward of feeling good (Duhigg 51).

In a study on weight-loss, participants either received no instruction or instruction upon self-monitoring(Beeken et al. 2). Eight weeks later, those participants who self-monitored lost 2 kg compared to 0.4 kilograms in the control group (Beeken et al. 2). Habits can be formed in short or long periods of

time, depending on the complexity of the habit. Motivational factors often do not influence strong habits, although they often influence non-habits and moderate habits (Neal et al., par 46). Strong habits are instead influenced by contextual cues (Neal et al., par 46). In Lally, et al.'s study, ninety-six people were asked to choose a new, healthy habit such as eating more fruit (1000). The new habit had to have a cue that only occurred once per day. Individuals wrote down if they performed this behavior each day (Lally et al. 1000). The study found habit formation occurred anywhere from 28 to 254 doors, with the average being 66 days (Lally et al. 1007). Repetition is a key for habit formation.

Habits can change, but usually much work is needed for these. For habits of moderate strength, goal associations are important for change (Neal, Wood, Labrecque, Lally, par 43). Duhigg states that in order to break a habit, a new habit must replace the old habit (72). Because the brain has received a cue and expects a reward that is given by a routine, a new routine must be substituted (Duhigg 76-77). However, belief is necessary for this to happen (Duhigg 78).

Changing habits can be hard, because habits are often based upon contextual clues. In a study by Wood, Tam, and Witt, they researched changes in habits when students change universities, monitoring students one month before and after the change (929-930). Because of contextual changes such as time of day or others being around, habits such as newspaper-reading changed (Wood, Tam and Wit 929-930). Additionally, to change habits, success is seen when advice is given to change habits in small ways (Beeken et al.10)

Gardner, Lally, and Wardle developed a tool to help doctors' patients change behavior (665). This tool was a 6-step plan to create a new, healthy habit (Gardner, Lally and Wardle 665). Participants picked a goal, formed a plan, and recorded how they did for 10 weeks(Gardner, Lally and Wardle 665). A key to the plan was the specificity of the plan (Gardner, Lally and Wardle 665). Their example goal was "to eat more fruits and vegetables", while the plan was "after I have lunch at home I will eat a piece of fruit," which included a what and a where (Gardner, Lally and Wardle 665).

To transform students' performance in mathematics, students need a way to be successful. By pinpointing a specific area to improve, overall mathematics performance should also improve. Locke

believed students should form habits early so later in life, the student would continue with that habit (15). In school, teachers need to ensure students are accurate and have a habit of being accurate. Catharine Beecher states "The simple fact that a teacher succeeds in making a child habitually accurate and thorough in all the lessons of school, may induce mental habits that will have a controlling influence through life" (69). According to Locke, "the great thing to be minded in education is what *habits* you settle" (19). Knowledge is important because "illiterate and semiliterate Americans are condemened not only to poverty, but also the powerlessness of incomprehension (Hirsch, 12).

To teach students, examples are necessary. Teachers should have students perform behaviors so those behaviors become a habit for the student (Locke 40). Also, teachers must encourage students to have strong habits within the math classroom. These include guessing, challenging solutions, looking for patterns, conserving memory, specializing, using alternative representations, classifying carefully, and thinking algebraically (Lavasseur and Cuoco 27-33).These can be demonstrated and taught in a variety of ways, but students will be more successful if they have these strategies. Guessing is important because it can lead to answers, or let students know if there answers are close. By challenging answers, students can help determine the reason or reasons an answer is correct or not. Looking for patterns allows students to begin algebraic thinking. Mathematics is not memorizing a bunch of formula, but understanding how those formulas work and applying them. By combining formulas and thinking of the formulas in groups, students can conserve memory and relate the topics more easily. Specializing involves looking at particular cases of something. For example, when doing trigonometry the quadrantal angles (angles that are a multiple of 90), drawing a reference triangle does not work. Using more than one way to represent a problem can help students understand both the problem and often how to figure out the solution. Diagrams, equations, and acting the problem out are various ways of representing the problem. Students are often quick to classify new ideas, but often do so incorrectly. By referring back to earlier techniques such as thinking about special cases, students can determine if they should classify a new idea in a particular way. Thinking of and using algebraic terms also leads to further skills.

Implementing these can be difficult. First, students need to be willing to try, and if students are not in the habit of trying, it can be very difficult to change. By allowing students the ability to guess and then check answers, not penalizing them, but guiding discussion, teachers can familiarize students with these techniques. Also, demonstrating techniques they themselves use is a way of modeling these to students.

These habits will allow students to be successful in future mathematics. However, if they do not have the groundwork they cannot be successful. E.D. Hirsch writes "The lack of wide-ranging background information among young men and women now in their twenties and thirties is an important cause of the illiteracy that large corporations are finding in their middle-level executives" (8). The table below is a similar one created by Gardener, Lally, and Wardle (665), adjusted for a mathematics classroom. Teachers can use this to help students form habits, beginning at the start of the year.

Math Class
Success in Mathematics

1. Choose a goal that you would like for this class.
2. Choose a simple (new) habit that will help you reach your goal.
3. Plan when and where you will do this simple action.
4. Each time you encounter that when and where, do and record this action.
5. As you proceed, it will become easier to have this habit.

My goal:

My plan: (include when and where)

Use this chart to record

	Quarter1, Week							
	1	2	3	4	5	6	7	8
Mon								
Tue								
Wed								
Thu								
Weekend								

By implementing this on the first day of the year, teachers can help students form good habits. Because habits often spill over when one habit is formed, students have a greater chance of success.

Habits are everyday reactions people have to given situations. While many people are unaware of habits, people spend their time in routines without thinking about the routine, instead focusing on other things. While habits are formed both consciously and unconsciously, they are important as they guide our lives. By making math students consciously aware of habits to use and helping them focus on a specific habit, teachers can help students be more successful in the math class.

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