

Wait-Time: Slowing Down May Be a Way of Speeding Up

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From *Journal of Teacher Education*, January-February, 1986

The wait time concept has become a significant dimension in the research on teaching. When teachers ask students questions, they typically wait less than one second for a student response. Further, after a student stops speaking, teachers react or respond with another question in less than one second. The concepts of wait time 1 (pausing after asking a question) and wait time 2 (pausing after a student response) are discussed in this article by Rowe. She reviews the literature on wait time and describes the efficacy of different training procedures used to enhance the quality of teacher questioning techniques and teacher responses to students. The appropriateness of using wait time with special needs students, particularly handicapped children, is also discussed.

This paper describes major outcomes of a line of research begun nearly 20 years ago by the author on a variable called wait time. To put it briefly, when teachers ask questions of students, they typically wait 1 second or less for the students to start a reply; after the student stops speaking they begin their reaction or proffer the next question in less than 1 second. If teachers can increase the average length of the pauses at both points, namely, after a question (wait time 1) and, even more important, after a student response (wait time 2) to 3 seconds or more, there are pronounced changes (usually regarded as improvements) in student use of language and logic as well as in student and teacher attitudes and expectations. There is a threshold value below which changes in wait time produce little effect and above which (2.7 seconds) there are marked consequences for both teachers and students.

The kinds of circumstances in which wait time 1 and 2 have been studied span elementary through college classrooms, mostly in science and literature. They range from docent programs in museums to rather diverse special education contexts (e.g., classrooms involving the mentally and physically handicapped and the gifted and talented).

An adaptation of the wait time concept for use in lectures appears to yield outcomes comparable to those mentioned above for classroom discussions, specifically, improvement in comprehension and attitude. Applications of wait time have been diverse, but the underlying patterns that make the variable so useful across such disparate contexts appear to be the same and will be discussed briefly later.

The wait time variable has an intuitive appeal. It makes sense to slow down a little and give students a chance to think. Unfortunately, it is difficult for many people to get average wait times up to 3 seconds or longer. The present 1-second or less wait times appear to be almost immutable and are definitely not culture dependent (Chewprecha, Gardner, and Sapianchi, 1980). Discussion of the difficulties encountered in establishing longer wait time patterns will illustrate that what appears to be a simple technique that makes a fundamental impact on the reasoning, roles, and norms in a classroom is, in fact, difficult to learn.

Effects of Wait Time on Students and Teachers

To "grow", a complex thought system requires a great deal of shared experience and conversation. It is in talking about what we have done and observed, and in arguing about what we make of our experiences, that ideas multiply, become refined, and finally produce new questions and further explorations. While listening to tape recordings of high school biology students discussing laboratory findings (Rowe and Hurd, 1966) and the conversations and "talk" in elementary school classes during a "hands-on" science program (Rowe, 1968; 1969a,b), the author made two observations common to both sets of data. The pace of interaction between teachers and students was very rapid for both elementary and high school classes, except for three recordings in each group where the pacing seemed slower and the level as well as the quantity of student participation was greater. Wait time 1, the interval between the end of a teacher question and the start of a student response, was 3-5 seconds on the average for the three special tapes in each set. For all the other recordings, wait time for pausing was less than 1 second and was too brief to measure reliably with a stop watch.

Effects on Students

To help document the astonishing speed at which teacher and student exchanges took place, I fed the sound from the tapes into a servo-chart plotter. The servo-chart plotter made a graph of the speech patterns and pauses and revealed another pause location that might be important, wait time 2. Wait time 2, the accumulation of pauses between student utterances before the teacher speaks again, in most of the recordings averaged 0.9 seconds, but on the three special tapes it exceeded 3 seconds. Servo-chart plots showed substantial pauses in the body of student explanations. Quick reactions by teachers appeared to cut off student elaboration. At this juncture it was necessary to determine if these protracted pauses of 3 seconds or longer, wait times 1 and 2, played a part in producing desirable student outcomes observed in the three tapes at each level or whether they were just interesting anomalies. To answer that question for the elementary group, teachers and staff members in the trial center and I began a series of studies that lasted a number of years and involved both small groups of students and whole classes. We manipulated wait times 1 and 2 separately and then together to observe what happens (Rowe, 1972; 1973; 1974a,b,c,d,e; 1975). In addition, I monitored the consequences of protracted exposure to longer wait time schedules in order to examine both immediate and long term effects. I found consequences for both students and teachers, highlights of which are listed below and all of which were subsequently verified by other researchers.

1. ***The length of student responses increases between 300% and 700%, in some cases more, depending on the study.*** Under the usual 1-second average wait times, responses tend to consist of short phrases and rarely involve explanations of any complexity. Wait time 2 is particularly powerful for increasing probability of elaboration.

Hanna (1977) did a study of the impact of extended wait time on quality of primary student responses to stories. Independent judges rated the quality of student responses higher under the 3-second treatment than under the control format of 1 second.

2. ***More inferences are supported by evidence and logical argument.*** Under 1-second wait times, the incidence of qualified inferences is extremely low, but it becomes quite common at the 3-second wait time threshold (Anderson, 1978, Arnold, Atwood, and Rogers, 1973).
3. ***The incidence of speculative thinking increases.***
4. ***The number of questions asked by student increases, and the number of experiments they propose increases.*** As a rule, students ask questions infrequently, and when they do, the questions are usually to clarify procedures and are rarely directed to other students. This situation changes rather dramatically under the 3-second regimen.
5. ***Student-student exchanges increase; teacher-centered "show and tell" behavior decreases.*** Under very short wait times, students compete for turns to perform for the teacher. There is little indication that they listen to each other. Under the 3-second regimen, however, they show more evidence of attending to each other as well as to the teacher, and as a result, the discourse begins to show more coherence. This outcome is particularly influenced by wait time 2, pauses after the first student responds.
6. ***Failures to respond decrease.*** "I don't know" or no responses are often as high as 30% in classrooms with mean wait times 1 and 2 of 1 second, which is the most common pace. Increasing wait time 1 to 3 seconds is particularly important for this outcome. During training, teachers often ask, "What if the student just doesn't know? Wait time will just be an embarrassment." The practical answer to that is to provide an "I pass" option. A student who has that option and exercises it at the end of 3 seconds is 70% more likely to be back in the discussion spontaneously before the period is over than is the case under the normal 1-second regimen.
7. ***Disciplinary moves decrease.*** Students maintained on a rapid recitation pattern show signs of restlessness and inattentiveness sooner than do students on the longer wait time treatment plan. At first this seems counter-intuitive to teachers. It appears that fast paced teacher questioning is a device for maintaining control of behavior. In fact it not only inhibits the kind of thinking teachers seek to encourage but it can also increase the need to discipline. The explanation may lie in a remark by a fifth grader to his mother about his teacher who was experimenting with 3-second wait times: "It's the first time in all my years in school that anybody cared about what I really thought—not just what I am supposed to say." Protracted wait time appears to influence motivation, and that in turn may be a factor in attention and cooperation.

8. *The variety of students participating voluntarily in discussions increases. Also, the number of unsolicited, but appropriate, contributions by students increases.* Under the short wait time pattern a major portion of responses comes from a small number of students: Typically six or seven students capture more than half of the recitation time. Under the 3-second regimen, the number of students usually rated as poor performers who become active participants increases. Interestingly, this change in verbal activity gradually influences teacher expectations for students because more students do more task related talking. (Verbal competence appears to be a salient factor in teacher judgments concerning a student's capabilities).
9. *Student confidence, as reflected in fewer inflected responses, increases.* Under a short wait time schedule, student responses are often inflected as though a tacit question such as "Is that what you want?" were attached to their statements. In a series of investigations to assess growth of confidence and a shift of reliance away from unsupported declarations by a powerful source, I presented a laboratory apparatus and a controlling variables problem to individual students chosen from different science settings (Rowe, 1968, 1969b, 1971). To assess the strength of an evidence-inference linkage, when subjects discovered and stated a relationship as a result of working with the apparatus I would say "I disagree." I wanted to observe what they did as a consequence. Could they persist through three disagreements? Some students came from the experimental science program classes with the usual short wait time pattern; others came from classes that in addition to the experimental science program also had 3-second wait time regimens. A third group of students came from classes still engaging in the city's standard science program. I found that three-fourths of the new-science and long-wait-time-group persisted through three disagreements by returning to the system, demonstrating their findings, and arguing the logic of their explanations. The other groups did much less well. For those in the experimental program under a short pause procedure, less than half lasted through three disagreements. For the standard program (largely from a book), only two percent met the criterion—most could not even make a start on the problem presented to them (see Honea, 1981, for consonant results in an attitude/wait time study using social studies content).

In a wait time investigation conducted with Pueblo Indian students, Winterton (1977) found that students who were previously described by teachers as nonverbal contributed spontaneously twice as often in the long wait time classes as did their counterparts in science classes operating on the short wait time regimen. Winterton also reported increased values on other verbal indicators identified by Rowe (see Rowe, 1973, 1978 for summary and training techniques).

10. *Achievement improves on written measures where the items are cognitively complex.* Tobin concluded that the wait time variable makes a significant contribution to performance on cognitively more complex test items at all three levels: elementary, high school, and college (Tobin, 1984; Tobin and Capie, 1982; Tobin, 1980). In his more recent work done in Australia, Tobin (1983, 1985) reports that average wait times there are even shorter than they are in the United States. Samples from two South American sources also show a shorter base line wait time. In both situations as well as in Thailand (Chewprecha, et al., 1980), increasing wait time to 3 seconds, particularly wait time 2 in science, improves language and logic variables and in some students written test performance, as well (see also Yeany and Porter, 1982).

Almost as soon as teachers begin the wait time procedure there are noticeable changes in speech and attitude outcomes. In fact, the promptness of changes, often detectable in the first hour, suggests that the wait time variable must have pervasive connections to both cognitive and affective factors. In a carefully designed and controlled study at the Smithsonian National Gallery of Art in Washington, Marsh (1978) found that even in groups of strangers, docents who used longer wait times could increase visitor engagements with ideas. Thus, it is a variable that does not rely on long standing prior acquaintance of students with each other to produce results.

Effects on Teachers

Once teachers stabilize longer wait time patterns, certain characteristics of their discourse change. These changes are treated as outcome variables because they are influenced by the wait time factor.

1. *Teachers' responses exhibit greater flexibility. This is indicated by the occurrence of fewer discourse errors and greater continuity in the development of ideas.* Under the short wait time schedule, the discourse does not build into

structural propositions. To put it in another way, there are more discontinuities in the discourse between students and teachers. Instead of a well-prepared banquet of ideas, the sequence of discourse resembles a smorgasbord at which everyone goes along, commenting on what she or he picks up, but paying no attention to the doings of others. One can calculate a discontinuity index for classroom discourse in much the way one does when evaluating a CAI program (Rowe, 1978). The index is higher for short wait time regimens.

2. ***The number and kind of questions asked by teachers changes.*** There are fewer questions, but more of them entail asking for clarification or inviting elaboration or contrary positions.

As teachers succeed in increasing their average wait times to 3 seconds or more, they become more adept at using student responses—possibly because they, too, are benefiting from the opportunity afforded by the increased time to listen to what students say. Boeck and Hillenmeyer (1973) reported that wait time 1 following a complex question tended to be longer than after a low level question. Rice (1977), Doerr (1984), and Hassler, Fagan, and Szabo (1980) confirm the original finding that increased wait times result in a cognitively more advanced pattern of teacher questions and reactions.

3. ***Expectations for the performances of certain students seems to improve.*** Under the longer wait time schedule, some previously "invisible" people become visible. Expectations change gradually, often signaled by remarks such as "He never contributed like that before. Maybe he has a special 'thing' for this topic." This effect was particularly pronounced where minority students were concerned. They did more task relevant talking and took a more active part in discussions (Rowe, 1969b, 1974e, 1975) than they had before.

While protracted wait times were never intended for use in drill and practice, neither I nor other researchers (e.g., Jones, 1980, Arnold, Atwood, and Rogers, 1974) have found markedly different wait time 1 values to be related to the level of question. I reported rather that this value was more influenced by teacher expectations. I asked teachers, prior to wait time training, to list the top five and bottom five students in their classes. Teachers gave the top five an average of 1.2 seconds of wait time 1 and the bottom five slightly less than 1 second (Rowe, 1974a,b,c,d,e;1978). Gore (1981) suggested that teachers gave more wait time to one sex than the other. However, his measurement of wait time did not conform to the definitions.

There is clearly a threshold value below which modifications in wait time produce little change in language and logic and above which (2.7 seconds) the effect is marked. When there is extended wait time that more nearly approaches the 3-second average, particularly for wait time 2, investigators report the same changes in teacher questions as did Rowe (e.g., Gooding, Swift, and Swift, 1983; Riley, 1979; 1980). Further, the proportion of student talk, as expected, increases. Andrus (1983) found that student questions increased in number and that a greater proportion of their questions tended to be at a high level of complexity than was the case for teachers. This is certainly indicative that increasing wait time produces modification of traditional roles as suggested by the paradigm described in the next section.

A Game Model of the Classroom

To understand something more of the changes that take place as a result of increasing wait time, imagine the classroom as a system consisting of two players, a teacher and a set of students. The set of students is considered to be one player (Rowe, 1973, 1974a, 1976b, 1978). There are four kinds of moves in this game:

1. Structuring: giving directions, stating procedures, suggesting changes.
2. Soliciting: asking questions.
3. Responding: answering solicitations, expanding on a structuring move, reporting data, or continuing a line of reasoning.
4. Reacting: evaluating statements made by self or other player.

In most games, satisfaction is high when both players have access to all the moves. In the classroom, on short wait time schedules the teachers typically monopolize three of the moves: structuring, soliciting, and reacting. Students have a corner on responding. By categorizing the moves and plotting them on a time line, we find that under a 3-second wait time regimen, students actually get to practice all four of the moves: they do more questioning of each other as well as the teacher and they do more reacting and structuring. With exposure to protracted wait-time schedules, the nature of the interaction game in the classroom changes. In training, if teachers make graphs by categorizing moves (from their transcripts) and placing them on a time line, they can observe how the "game" changes.

Training for Wait Time

In their eagerness to elicit responses from students, teachers often develop verbal patterns that make the achievement of wait time 2 unnecessarily difficult. Chief among the inhibitors is the habit of mimicry, repeating part or all of what a student says. A high mimicry rate cuts off extended wait times and reduces the quantity and quality of student responses. An anecdote illustrates the unintended consequences of a mimicry pattern. In a classroom where the teacher was changing this pattern in order to increase wait time 2, one of the students asked, "Mrs. B. how come you are not repeating things any more?" Before she could reply, another student answered the question. "I know. She knows that we can tell from the tone of her voice which answers she likes and which she doesn't, and we can stop thinking."

There are other verbal signals to consider avoiding or reducing in conjunction with wait time, e.g., "Yes...but ..." and "...though" constructions because they signal the student that an idea is about to be rejected without the consideration due it.

Various procedures have been tried to help teachers learn to increase wait times (e.g., Anshutz, 1975; Atwood and Stevens, 1987). So far, the procedure that gets the most people to achieve relatively stable criterion 3-second wait times in classroom settings takes longer than we would like, 6 to 12 hours. Moreover, it is a bit aversive because it involves transcribing 10-minute segments of tape recordings from three teach-reteach cycles using groups of four students. (When teachers work with small groups, wait times are as short as when they work with a whole class, Rowe, 1973). The procedure is further complicated by the fact that teachers have seen their servo-chart plots for each teach-reteach cycle.

With the teach-transcribe-reteach procedure, 70-80 percent of people achieve 3-second criterion wait times (Rowe, 1973, 1974a,b, 1978; McGlathery, 1978). One must be aware, however, that in the third or fourth week after teachers start using longer wait times in their classes, they revert to the original fast pace unless they have a chance to talk about what they are experiencing. What appears to happen in this transition interval is that grounds for decision making are less clear cut than was the case under the fast schedule. For example, teachers cannot decide how long to let student-student interaction go or how they feel when students begin to enact more of the game moves and they, in turn, make fewer moves. In short, there are role and norm transformations taking place, and until these get settled, some teachers feel uncomfortable. A little support during this transition, even some advance warning that it will happen, appears to be sufficient to reinstate the 3-second wait time average and to get teachers through the transition period.

Garigliano (1973) followed a teach-reteach regimen in a wait time training experiment but dropped the transcribing procedure out of one group in favor of having teachers listen to their tapes and identify and measure both species of wait time. His best performing treatment group (transcribed) attained 2.8-second averages. He confirmed the student effects described by Rowe, provided that average wait times did not drop much below this value.

DeTure (1976, 1979) contrasted the effectiveness of audio and video tape and written models for teaching wait time. Her subjects who were exposed to the video and audio models, achieved 2.7 seconds average wait times, the minimum levels regarded as necessary to produce the outcomes reported in the literature (Rowe, 1978).

Swift and Gooding (1983) and DeTure (1984) found that written training protocols are virtually useless in helping teachers achieve 3-second wait times. In Swift's study, teachers averaged 1.35 seconds for wait time 1 and 0.68 seconds for wait time 2, values that differed little from the means of his untrained group. Similarly, DeTure reported averages of 1.47 and 0.87 seconds for wait time 1 and 2 respectively for people trained with written or oral protocols.

Swift and Hawkins (1979) and Gooding, et al (1982) introduced an electronic monitoring device, the basic concept for which was initially developed jointly with Rowe, as a substitute for the feedback function supplied by the servo-chart plotter. Their voice-actuated relay system flashed a green light when wait times were satisfactorily long and a red light when wait times were too short. Teachers could have immediate wait time feedback while they were interacting with students. This method did result in some improvements, but did not help the group attain criterion wait times until the procedure was accompanied by supportive intervention. Swift, Swift, and Gooding (1983, 1984) reported that when the wait time devices were removed, despite supportive intervention, teachers reverted to short wait times. It may be that the presence of the mechanical device, while somewhat helpful, prevented teachers from attending to the fundamental changes in the nature of the game that takes place with longer wait times, namely, the decisions occasioned by subsequent shifts in roles and norms.

DeTure (1985) remarks at the conclusion of a review of training procedures that the quick fix for this variable may not be feasible. Transcribing tapes as part of the training procedure in teach-transcribe-reteach cycle is time consuming but remains the procedure that enables more people to achieve a 3-second average wait time and successfully transfer it to the classroom.

Based on research it is clear that wait time 2 is more important than wait time 1 in many of its effects. Ironically, some training programs and teacher competency rating schemes mistakenly focus only on wait time 1 (DeTure, 1985).

All the training techniques may be useless if teachers believe they will lose control of the class under the longer wait time schedule. As the Soars so aptly observed (1983), teachers confuse management of ideas with management of discipline. They need to know that behavior management is actually easier with protracted wait times (Rowe, 1974a).

There is some difference among researchers on how wait times should be classified. Fowler (1974; 1975), for example, breaks wait time into four little bits according to whether he thinks the pause is primarily student-initiated or teacher-initiated or whether it is a reaction pause. It seems to me that this kind of reductionism unnecessarily complicates the picture for practitioners as well as for those involved in theory development because his results largely coincide with those of Rowe as well as of Lake (1973). Moreover, it is difficult enough to sensitize people to two wait-time locations without tripling the number as Fowler suggests.

Measurement of Wait-Time

Measurement of wait time with a stop watch is unsatisfactory for research purposes because the pauses are too brief and too frequent to get reliable data. However, it is quite adequate for training because precision of 1-second is close enough for that purpose.

Rowe used a servo-chart (1974a; see also DeTure, 1976, and Garigliano, 1973) to measure wait time as part of teacher training. If used correctly, servo-chart plotters give accurate measures, but as in all automated measurement involving sound, the operator needs to distinguish between miscellaneous classroom noises and discourse events. McDougal (1979) used a microcomputer to measure pauses, but because the procedure was not automated (i.e., depended on reaction time of the operator) the error rate was quite high. Swift and Gooding (1982) improved the measurement situation by using an analog to digital conversion of incoming data and reported (1983) good precision (to .01 seconds). Still somewhat unclear is how their procedure discriminates between speech events and random classroom noise.

Adaptation of Wait Time for Lecture Formats

Often in high school, and particularly in college, there is a need to convey complex content, and the lecture appears to be the most commonly chosen format. For the lecture situation, I developed a 10-2 procedure for college and the 8-2 for high school. Based on a theory about how short-term and long-term memory interact, I identified four types of mental lapses that take place on the part of listeners in science classes (Rowe, 1976a, 1980, 1983).

Using the 10-2 and 8-2 formats, participating science faculty would lecture for 8 to 10 minutes, then stop for 2. In the strictly regulated 2 minute intervals, students in sets of three shared their notes and helped each other clarify concepts. All unresolved questions were to be reserved for the last 5 minutes of the period. Experimental groups following this regimen generally show improved performance over control groups on the more complex test items, more delayed retention, and more positive attitudes toward the subject and method. The quality of student questions also improves as does the usefulness of their notes.

Rewards

Another line of research that impacts on the wait time situation deals with teacher sanctioning. The effects of protracted wait times are enhanced if the teacher sanctioning pattern (either positive or negative statements by the teacher) is reduced. That is, a high positive or negative sanctioning pattern reduces some of the effects of protracted wait times, particularly the following: student confidence, speculation, and elaboration (Rowe, 1974b,d; also see McGraw, 1978; Soar and Soar, 1983).

Special Education

Exposure to longer wait times is as useful to talented students as it is to lesser ability youngsters. Gifted and talented high school students participating in a summer science program found the extended wait times particularly motivating, for the same reason as did the fifth grader mentioned earlier. Bright students see many connections between ideas but they never get to talk about them. With increased wait time, the changes in their production of ideas, in the variety of moves under the game model of the classroom, and in their expressions of relief at being able to go beneath the surface ideas, are evident. Servo-chart plots of their explanations show that explanations come in bursts separated by substantial pauses (often in excess of 5 seconds), as does the speech of most students if they are not interrupted during the process by short wait time 2 intrusions. Thus the protracted wait times help both fast and slow learners, but for different reasons.

Two recent studies, one with mildly handicapped subjects and one with severely handicapped, showed some desirable outcomes for a 5-second interval as opposed to the usual 1-second pace (Korinek, 1985; Lee, 1985). In these cases, fundamental processing just takes more time. Extended wait time 1 was particularly important in the study by Lee.

Shrum (1985) found that wait time 2 (post response wait time), in second language classes, is even shorter (.73 seconds) than the .90 seconds reported by Rowe, much too short for thoughtful cognitive processing. She reports that average wait times are longer following questions in the native language than they are in the second language (see also Rochester, 1973).

Conclusion

Under a wide variety of instructional situations and levels ranging from first grade through university level, from classrooms to museum and business settings, the quality of discourse can be markedly improved by increasing to 3 seconds or longer the average wait times used by teachers after a question and after a response. These pauses are ordinarily so brief, 1 second or less on the average, that an adequate exchange of ideas and the nurturing of new ideas cannot take place. Wait time, however, is just another technique if one does not understand why fostering more productive exchanges among us all is so important. Gwen Frostic, a poet and artist, tells us in her book *Beyond Time*,

We must create a great change
in human direction—
an understanding
of the interdependency
by which the universe evolves
Know
—that knowing—
is the underlying foundation
for the life we must develop...
We cannot leave it to the scientists—
nor any form of government—
each individual
must fuse a philosophy
with a plan of action.

Wait time provides a context in which teachers and students may dialogue together in the service of that purpose.

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