EFFECT OF ACQUISITION RATES ON OFF-TASK BEHAVIOR WITH CHILDREN IDENTIFIED AS HAVING LEARNING DISABILITIES

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Abstract. Research has consistently demonstrated the importance of providing an appropriate level of challenge, called the instructional level, within curricular material. Although the instructional level is a generally well-defined and researched construct, much less data exist on the acquisition rate (AR) component of an appropriate level of challenge. The current study used curriculum-based assessment to assess the AR of five fourth-grade students diagnosed with a reading disability and taught each 20 words from the Esperanto International Language over two sessions (10 each session). Students were observed during instruction, and the number of demonstrated off-task behaviors was converted to a mean rate of off-task behaviors/minute. Comparison of pre- and post-AR data showed that each student demonstrated an increase in off-task behaviors while rehearsing the word that immediately exceeded his or her AR. Implications for practice and suggestions for future research are discussed.

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Research has consistently demonstrated that matching the difficulty of instructional material and student skill level increases outcomes such as task completion, task comprehension, and student time on task (Daly, Martens, Kilmer, & Massie, 1996; Gickling & Armstrong, 1978; Gickling & Rosenfield, 1995; Gickling, Shane, & Croskery, 1989). This match between material and skill can be assessed with curriculum-based assessment (CBA; Gickling & Havertape, 1981) by computing the percentage of known items within the academic task and comparing it to an optimal level, called the instructional level.

Reading tasks must include 93% to 97% known words to represent an instructional level, and tasks that involve rehearsal or practice of individual items (drill; e.g., rehearsing math facts, learning sight words) must include 70% to 85% known items (Gravois & Gickling, 2002). If the learning material contains less than 93% known material for a reading task, or less than 70% for a drill task, the child may experience frustration due to the mismatch between student skill and challenge level of the learning activity. This mismatch may also serve as a source for intervention, in that steps can be taken to more closely match curricula and student skill (Burns, 2002; Shapiro, 2004). Although the proposed ratios of known material were hypotheses, independent empirical research has supported interventions based on these ratios (Burns, 2002, 2004a; Gickling et al., 1989; Roberts & Shapiro, 1996; Shapiro, 1992; Shapiro & Ager, 1992).

The instructional level includes a second, less-researched component called the acquisition rate (AR), which is the amount of new information a student can successfully rehearse and later recall during initial instruction (Burns, 2001). Cesaro's (1967) seminal research found that a child's attempt to complete an instructional set that exceeded his or her individual limit resulted in an inability to learn new information and reduced retention of previously learned material. Therefore, Gickling and Thompson (1985) proposed that, in addition to including enough known material in the learning task to arrive at the appropriate level of challenge, the amount of new information a student can learn at one time must also be considered. That is, the student may become frustrated if the amount of new material being introduced, even if presented with an appropriate ratio of unknown to known material, exceeds the student's AR, possibly leading to increased off-task behavior.

Moreover, research has identified individual differences in the amount of information children retain from one instructional session (Brainerd & Reyna, 1995). This may be due to several variables, including prior experience with the information (Rabinowitz, Ornstein, Folds-Benett, & Schneider, 1994); content of the material (Scweickert & Boruff, 1986; Semb & Ellis, 1994); and developmental factors (Fry & Hale, 1996; Gathercole & Baddeley, 1993; Miller & Vernon, 1996). Student ARs, as measured by CBA, have also revealed individual differences in the amount of new information successfully rehearsed, consistent with previous memory research (Burns, 2004b), but data examining the effect of ARs on behavioral outcomes such as off-task behavior are lacking in the literature.

Reducing off-task behavior could directly affect learning because academic learning time (ALT), defined as the "proportion of instructional time allocated to a content area during which students are actively and productively engaged in learning" (Gettinger & Siebert, 2002, p. 774), has been closely linked to academic outcomes (Gettinger & Stoiber, 1999). Therefore, it makes intuitive sense that time on task, or a reduction in time off task, would also be linked to positive academic outcomes.

On-task behavior was defined in early CBA research as student behavior that was engaged in tasks relevant to the assignment (Gickling & Armstrong, 1978). Conversely, off-task behaviors were those that were irrelevant to the academic task at hand. Although these definitions are somewhat vague and seem more consistent with procedural engagement (observable behaviors; Nystrand & Gamaron, 1991) than substantive engagement (prolonged personal commitment), both are necessary for ALT (Gettinger & Siebert, 2002).

Further, procedural engagement was linked to a high level of academic success (Gickling & Thompson, 1985), which Gettinger and Siebert (2002) suggested presents a best practice for increasing ALT. Finally, task-relevant behavior has been linked to student outcomes in CBA research (Gickling & Armstrong, 1978), but off-task behavior was presented as primarily a manifestation of student frustration. The latter assumption requires additional empirical scrutiny.

When students are taught at their instructional level, they experience increased task engagement, presumably manifested by on-task behavior (Gickling & Thompson, 1985; Gravois & Gickling, 2002). As stated earlier, previous research demonstrated that providing instruction at a child's instructional level resulted in increased task completion, task comprehension, and time on task (Gickling & Armstrong, 1978; Shapiro, 1992; Shapiro & Ager, 1992; Thompson, Gickling, & Havertape, 1983). However, these studies examined the percentage of known material within the learning task, and did not address the acquisition rate component of the instructional level. Moreover, only early research regarding the instructional level (Gickling & Armstrong, 1978; Thompson et al., 1983) used off-task behavior as a dependent variable, but remains a proposed benefit of teaching children at their individual instructional level (Gravois & Gickling, 2002).

Given that 25% to 40% of children identified as having learning disabilities (LD) also experience significant attention difficulties (Mayer, Calhoun, & Crowell, 2000), additional research on both aspects of the instructional level using off-task behavior as the dependent variable seems warranted. The current study examined rates of off-task behavior before and after each child obtained his or her AR. It was hypothesized that the rate of off-task behavior would increase immediately after each child reached his or her AR.

METHOD

Participants and Settings

Three fourth-grade boys and two fourth-grade girls participated in the study. Each was Caucasian, either 9 or 10 years old, and attended one elementary school in a rural Michigan community. All five met the Michigan criteria for specific learning disability (R340.1713; Michigan State Board of Education, 2002) in basic reading skills and had participated in special education since the second grade. Each child had been administered a Wechsler Intelligence Scale for Children: Third Edition within the previous 24 months, resulting in age-based full-scale quotients between 90 and 95. In addition, the students' Individualized Educational Program addressed difficulties sustaining attention and included a goal regarding increased time on task during instructional

activities. None of the students was prescribed medication for attention difficulties during the study.

Students were seen individually within a quiet area in their elementary school outside of their classroom. The room was large enough to seat the primary researcher and the student at one table across from each other, and to accommodate three school psychology graduate students so their presence was not distracting to the student. Although the work area was away from the classroom, school and class activities were viewable by the student.

Materials

Before beginning the instructional sessions, the students' individual ARs were assessed using procedures outlined by Burns (2001). Each student was taught a series of individual unknown words by rehearsing them among known words at a ratio of one new word to nine unknown words. The new words were individually added until the child made three errors while practicing a new word. At that time the number of words folded in and successfully completed was recorded as the AR. For example, Student 1 rehearsed the first four unknown words while making few errors, but he made three errors while completing the fifth word, thus Student 1's AR was 4.

Because Gickling and Armstrong (1978) used academic behaviors, such as time on task, as a dependent variable, the current study examined similar behaviors. Three school psychology graduate students trained in behavioral observations observed each student while timing the session as it was implemented and recording the number of off-task behaviors. Off-task behaviors were defined as the student not "having his head and/or eyes oriented toward assigned material, an appropriate speaker, or another presentation medium" (Skinner, Rhymer, & McDaniel, 2000, p. 23), and were assessed using an event-recording method described by Hinze, Volpe, and Shapiro (2002). If off-task, students were immediately redirected by the researcher to control the duration of the off-task behavior.

In order to be accepted as off task, a rating had to be noted as such by two of the three observers. A total of 94% of the observed incidents was unanimously judged as off task. The data were then converted to a rate of off-task behavior by dividing the number of off-task behaviors during instruction by the total number of minutes taken to complete the session.

Words from the Esperanto International Language (Richardson, 1988) were taught. These words were selected to control for prior and external experience with the material, a criticism levied against many memory studies (Semb & Ellis, 1994), and because English translations could be used to assign meaning to the words. It was assumed that the children had no prior experience with this language and did not receive any additional instruction in it during the testing period. Esperanto was also used in previous AR research (Burns, 2001, 2004b). Concrete nouns of five letters were selected from Esperanto for use to control for the size and imagery level of the word. Known words were obtained during the first session by presenting the fourth-grade list of the Fry (1980) reading list to each student and asking them to state the known words. Words that were correctly read within 2 seconds were recorded as known words and were used as such in the study.

PROCEDURE

Students were seen individually at their school once a week for three weeks. The first session consisted of measuring students' AR using Esperanto words. Sessions Two and Three each involved teaching 10 new Esperanto words and their corresponding English translations. Words were individually taught by writing the word on a 3" x 5" index card and presenting the word on the card while verbally stating its pronunciation and English translation. The student was then asked to restate the word and its English translation. Once the student correctly stated the unknown word and its translation, it was rehearsed using incremental rehearsal (IR; Tucker, 1989) to control for instructional methodology. IR rehearses unknown words by incrementally folding them in among known words using the sequence outlined in Table 1. Comparing IR to other instructional drill models, MacQuarrie, Tucker, Burns, and Hartman (2002) found that it led to significantly better retention after as many as 30 days.

The number of off-task behaviors/minute pre- and post-AR was compared. For example, if a student had a measured acquisition rate of 4, his behavior while rehearsing the first four unknown words was compared to behavior while rehearsing the last six unknown words.

RESULTS

It was hypothesized that the children would exhibit more off-task behavior after reaching their individual AR. The AR for each student, assessed during the first session, resulted in an AR of four items for Students 1, 2, and 5, and two items for Students 3 and 4.

Off-task behaviors prior to and after obtaining the students' AR were compiled by computing the rate of off-task behavior for each word in the instructional sequence, and taking the mean rate of off-task behavior between two sessions. Figure 1 graphically displays each student's mean off-task behaviors/minute prior to and after reaching AR, suggesting an increase in post-

Table 1
Steps in Incremental Rehearsal

1. Present first unknown word

Present first known word

2. Present first unknown word

Present first known word

Present second known word

3. Present first unknown word

Present first known word

Present second known word

Present third known word

4. Present first unknown word

Present first known word

Present second known word

Present third known word

Present fourth known word

5. Present first unknown word

Present first known word

Present second known word

Present third known word

Present fourth known word

Present fifth known word

6. Present first unknown word

Present first known word

Present second known word

Present third known word

Present fourth known word

Present fifth known word

Present sixth known word

7. Present first unknown word

Present first known word

Present second known word

Present third known word

Present fourth known word

Present fifth known word

Present sixth known word

Present seventh known word

8. Present first unknown word

Present first known word

Present second known word

Present third known word

Present fourth known word

Present fifth known word

Present sixth known word

Present seventh known word

Present eighth known word

9. Present first unknown word

Present first known word

Present second known word

Present third known word

Present fourth known word

Present fifth known word

Present sixth known word

Present seventh known word

Present eighth known word

Present ninth known word

Figure 1. Mean off-task behaviors before and after reaching individual acquisition rates.
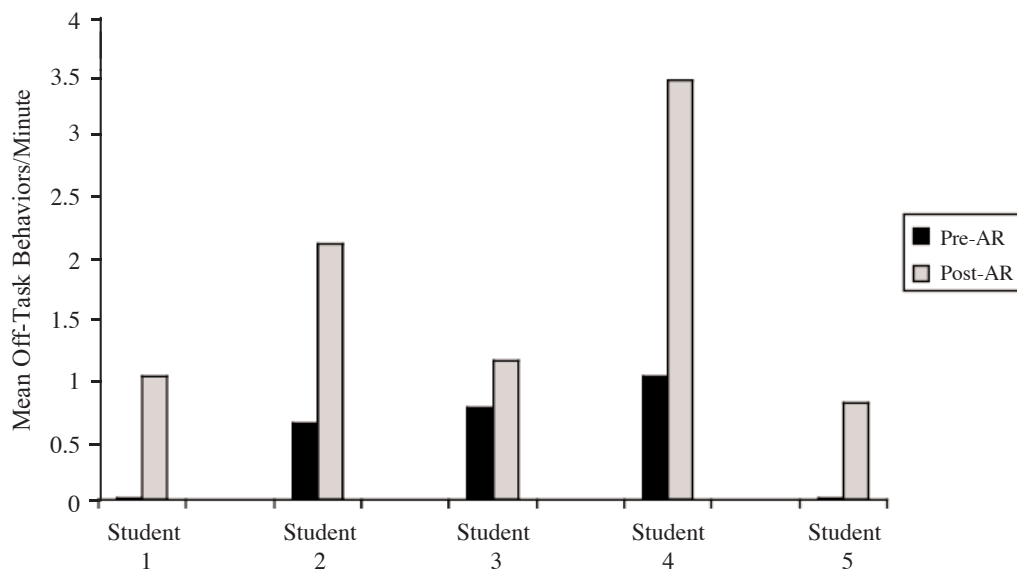
AR mean off-task behavior for each student. The mean pre-AR off-task behavior was .56 behaviors/minute (*SD* = .72). Post-AR behaviors resulted in 1.63 mean off-task behaviors/minute (*SD*=1.73).

Figure 2 displays each student's mean rate of off-task behavior over two sessions for each word in the sequence while individually rehearsing the 10 unknown words. Every student experienced an increase in off-task behavior while rehearsing the word that directly exceeded the AR, with three of the five students never dropping below the rate of off-task behavior while rehearsing the word that represented the AR.

Figure 3 shows the rate of off-task behavior for each word in the 10-word sequence after grouping the students by AR and plotting their mean number of off-task behaviors while rehearsing each word. As illustrated, both sets of students experienced an approximately threefold increase in off-task behavior after immediately exceeding the acquisition rate.

DISCUSSION

The current study examined the AR, one aspect of the instructional level as defined by Gickling (Gickling & Thompson, 1985; Gravois & Gickling, 2002), using

time off task as the dependent variable. The data generally supported the hypothesis that children exhibited less off-task behavior prior to reaching their individually measured AR, compared to attempts to rehearse material that exceeded the AR.

Research has suggested that the more time spent on a task, the greater the likelihood of off-task behavior (Darch & Gersten, 1985). The current study attempted to pinpoint when the off-task behavior increased using Gickling's rate of acquisition rather than time, hypothesizing an increase in off-task behavior after reaching the AR.

All five students exhibited an increase in off-task behavior immediately after completing the word that represented their individual AR. However, the amount of time required for each student to reach his or her AR varied in that Student 1's AR was four items and Student 4's AR was two items. Thus, Student 4 reached her acquisition rate in less time than Student 1, but both demonstrated an increase in off-task behavior while learning the word that immediately exceeded the AR.

For Students 3 and 5, the off-task behavior returned to earlier rates for the final three words. Researchers have suggested that the completion of an academic

Figure 2. Pre- and post-AR off-task behaviors/minute for individual students.
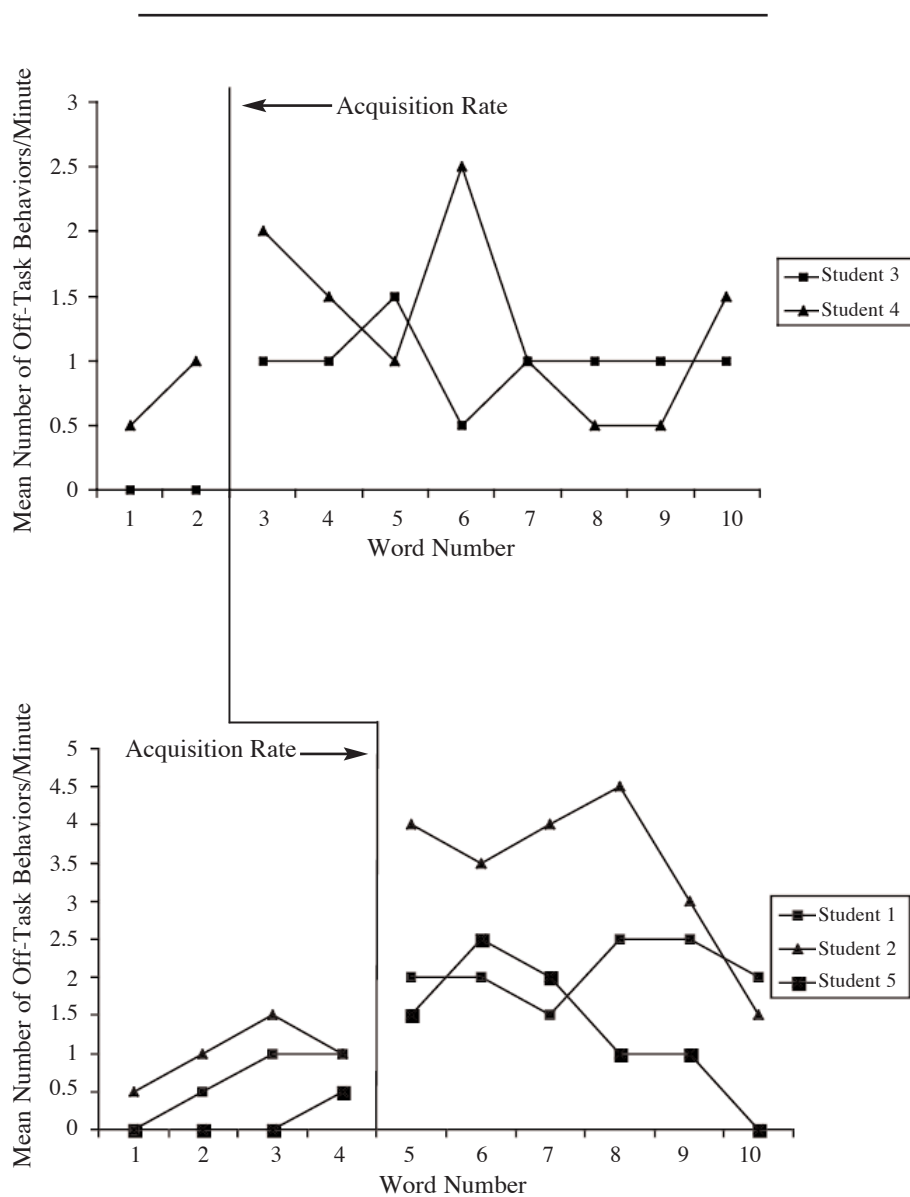
task may be reinforcing (Logan & Skinner, 1998; Skinner, Robinson, Johns, Logan, & Belfiore, 1996). Perhaps these students recognized they were nearing the completion of the instructional session and, therefore, experienced reinforcement by completing the task. This effect was reduced when the data were grouped by ARs, because the rate of off-task behavior did not return to lower levels as seen before reaching the acquisition rate.

In order to fully examine these data, some limitations should be noted. First, to improve the internal validity of the study artificial stimuli were listed for instruction and the instructional sessions were conducted outside of a classroom setting. Although controlled conditions

are desirable in research, this may limit the external validity of the data. Second, an event approach was used to determine off-task behavior, in that the number of off-task behaviors was calculated without reference to duration. Given that in a classroom setting the amount of time a child is engaged in off-task behavior may not correlate exactly with the number of incidents (e.g., Student A could be briefly off task 10 times but Student B could be off task 5 times with much longer durations, and thus spend more time off task), an event-recording schedule assessed only one aspect of task irrelevant behavior, and therefore limited the generalization of findings. Third, reducing off-task behavior may not necessarily increase other student outcomes such as

Figure 3. Pre- and post-AR off-task behaviors/minute for students grouped by AR.
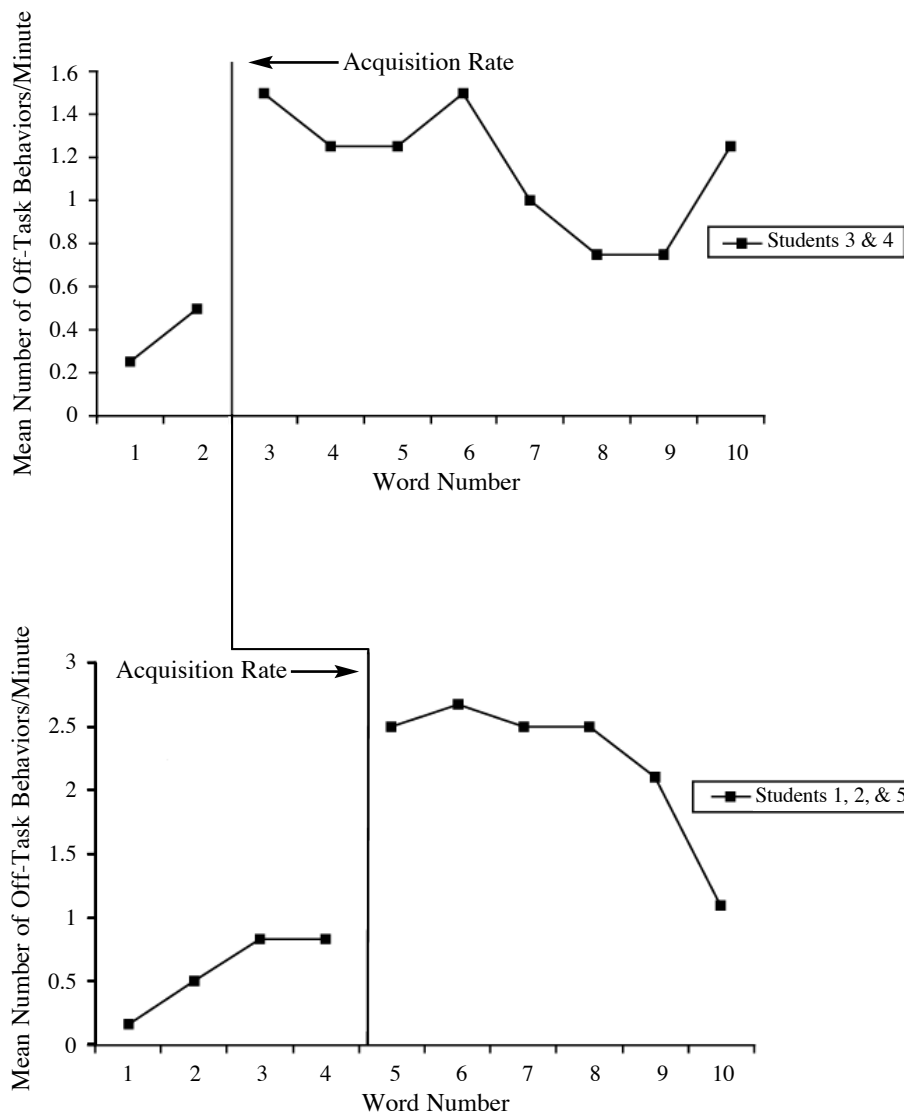
retention of learned material. Therefore, studies that use interval approaches to measure off-task behavior and that include other student outcomes as dependent variables would greatly add to the AR literature. It may be especially interesting to ascertain if words rehearsed before reaching the AR are more frequently retained than words rehearsed after the AR. Finally, future researchers may wish to examine the content specificity of ARs.

Implications for Practice

Given the lack of research on acquisition rates, the primary goal of the current study was to provide basic research. However, the data could suggest some implications for practice after giving due consideration to the limitations listed above. Specifically, providing an appropriate level of challenge meant more than just including a percentage of known items while rehearsing new material. Educational professionals involved in the instruction of children, especially those identified as having LD, should also consider the amount of information being introduced. The students in the current study demonstrated ARs of 2 and 4. Thus, learning sets for these children should be limited to only two or four new items, which are probably smaller than many learning sets in practice.

Practitioners use drill rehearsal techniques to remediate a number of academic difficulties because rehearsing basic skills through drill tasks consistently leads to increased performance of more advanced skills (Dehaene & Akhavein, 1995; Jones & Christensen, 1999; Tzelgove, Porat, & Henik, 1997). For example, teaching unknown words to children in a drill format generalized to increased reading skills (Roberts & Shapiro, 1996), and preteaching unknown key reading words with incremental rehearsal led to increased reading fluency and comprehension (Burns, Dean, & Foley, 2004). The current data suggest that practitioners who use drill rehearsal techniques should limit the size of the set based on the individual child's AR, which in practice may simply mean that new items are introduced until the child makes three errors while rehearsing one item.

After completing more basic research, future research could address several applied topics such as classroom uses of interventions based on the two dimensions of the instructional level, and modifying the amount of information presented at one time, based on students' ARs, to improve academic outcomes. Moreover, future researchers may wish to compare this intervention to reduce off-task behavior frequency and duration with other approaches discussed in the research literature. Regardless of the basic or applied nature of future studies, additional research in this area appears warranted.

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