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High-Preference Strategies and other Interspersal Procedures for Learners with Disabilities: A Review of the Literature

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Interspersal Procedures (IP) represent a group of interventions that imbed, at varying ratios, requests for individuals to exhibit mastered skills before or within sequences of requests for target skills. Interspersal Procedures include numerous strategies, such as high-probability request sequences, pre-task requests, and high-preference strategies. Such arrangements can increase attempts to perform target or less preferred tasks. The purposes of this review include (a) an overview of terminology related to IP, (b) a discussion of the conceptual basis for using IP, (c) a description of the experimental literature that has used IP with individuals with disabilities, (d) a categorical summary of this literature, and (e) a discussion of pragmatic concerns and guidelines for deciding when to use IP.

Keywords: interspersal procedures; high-preference task requests; discreet task completion hypothesis; disabilities; behavioral momentum; premack principle

The literature uses various terms to describe the strategic manipulation of the ratio of mastered to target skills, including interspersal procedures (Neef et al., 1977), high-preference strategies (Banda, Matuszny, & Therrien 2009), high-probability command/ request sequences or pre-task requests (Cooper, Heron, & Heward, 2007; Mace et al., 1988), in-cremental rehearsal (Burns, 2005), and task variation (Dunlap, 1984). For the purpose of parsimony, and because the term interspersal procedures (IP) is both seminal and representative of the aforementioned strategies, this review uses IP as an umbrella term that refers to any strategy that systematically embeds maintenance/high-preference/high-probability behaviors or skills within requests for, or assignments that include, target/low-preference/low-probability behaviors or skills. With respect to this review, the terms maintenance, high-preference, and high-p behaviors, skills, tasks, or items will be grouped together as counterpoints to the terms target, low-preference, and low-p.

Mastered skills can be described as those that are considered to be in maintenance. Skills in maintenance are those for which an individual has met a performance criterion (acquisition) and demonstrated consistent competence (Hulac & Benson, 2012; Neef, Iwata, & Page, 1977) following the removal of intervention variables (e.g., instruction), such as the consistent correct identification of a vocabulary word. Un-mastered skills are target skills that are characterized by inconsistent, inaccurate, or no responding to task requests, as exemplified by errors in identifying vocabulary words. High probability (high-p) behaviors are those that an individual is likely to attempt or complete given the presence of requisite discriminative stimuli (e.g., a ball and the request "Hand me the ball."). However, because probability is a relative term, high-p is designated in comparison to low (or discernibly lower) probability behaviors (low-p). The likelihood of initiating and completing work on relatively easier math (reciting mastered math facts) versus working on comparatively difficult math (attempting unfamiliar math equations) exemplifies this comparison.

The literature has well demonstrated that the manipulation of the ratios of task requests for high-p to low-p behaviors, where a sequence of requests to perform mastered, or maintenance, skills are imbedded in requests to perform un-mastered skills (or mastered skills that are more difficult or relatively more "aversive"), can result in skill acquisition, as well as increased compliance and instructional engagement of learners with disabilities (Cooke & Reichard, 1996; Cuvo, Davis, & Gluck, 1991; Mace & Belfiore, 1990; Neef et al., 1977). Specifically, there is considerable empirical support of the effectiveness of IP with learners with disabilities across a variety of dependent variables, including: Mathematics computations (Burns, 2005; Cooke & Reichard, 1996; Lee, Stansbery, Kubina, & Wannarka, 2005); students' perceptions of task difficulty (Cooke & Reichard, 1996; Teeple & Skinner, 2004; Wildmon, Skinner, Watson & Garrett, 2004); sightword reading (Browder & Shear, 1996; Burns, Dean, & Foley, 2004; Neef et al., 1977; Burns & Kimosh, 2005); reading fluency and comprehension (Cooke, Guzaukas, Pressley, & Kerr, 1993; Burns, Dean, & Foley, 2004); spelling (Cooke et al., 1993; Neef et al., 1977; Neef, Iwata, & Page, 1980); functional and self-help skills (Cuvo, Davis, & Gluck, 1991); independent object labeling (Ormsby & Belfiore, 2009; Volkert, Lerman, Trosclair, Addison, & Kodak, 2008); time on-task/student engagement (Mace & Belfiore, 1990; Skinner, Hurst, Teeple, & Meadows, 2002); compliance (Mace et al.,1988; Singer, Singer, & Horner, 1987); aggression (Horner, Day, Sprague, O'Brien, & Heathfield, 1991); self-injurious behavior (Horner, Day, Sprague, O'Brien, & Heathfield, 1991; Zarcone, Iwata, Hughes, & Vollmer, 1993); gross motor skills (Weber & Thrope, 1989); learning of picture names (Rowan & Pear, 1985); and food acceptance (Patel et al., 2006).

The purpose of this review is to provide a thorough treatment of the literature base that has employed IP as an intervention for individuals with disabilities. First, the conceptual framework for using IP strategies is presented, followed by a thorough description of the experimental literature on IP with individuals with disabilities. A summative description and analysis of the literature is then presented, including limitations and implications for future research. Finally, a discussion on the pragmatic concerns and recommendations for using IP is given.

Conceptual Framework for IP

Several constructs can be linked to IP. The Premack Principle (Premack, 1959, 1962, 1965, 1971) states that making access to high preference activities or behaviors contingent upon the exhibition of low preference behaviors or activities will increase the probability of the lower preference behavior. Related to IP, as reinforcement associated with mastered (hi-p) tasks is made contingent upon responding to target (low-p) tasks, rates of responding to difficult items increases because they are more frequently produce reinforcement. Note that this description presumes and that the high-p tasks either inherently provide reinforcement or are associated with a history of reinforcement. It is also possible that the high-p activities or tasks are merely less aversive, comparatively, than the low-p tasks, and that escape from the low-p task is negatively reinforced by task completion, and perhaps positively reinforced by the less aversive (i.e., higher-p) task. This argument is predicated on discrimination that completion of a low-p task is likely to produce escape to the high-p task).

High-probability command sequencing (Mace et al., 1988), in which multiple high-p task requests are presented prior to a low-p request, is one type of IP strategy. Mace and colleagues (1988) reported greater compliance to low-p requests when they were preceded by multiple high-p requests, and related these findings to the construct of Behavioral Momentum (Nevin, 2012; Nevin, Mandell, & Atak; 1983), which describes the tendency for behavior that has been intermittently reinforced at a relatively greater rate in the presence of a stimulus to persist longer given a disruption (e.g., extinction) than behavior that has been reinforced at a relatively lower rate, assuming discrimination of signaled reinforcement. However, the fit between high-p command sequences and the construct of momentum, to be tenable, must demonstrate that increasing the ratio of high-p requests preceding a low-p request results in an increased reinforcement schedule for low-p requests.

Also relevant to the discussion of IP, the Discreet Task Completion Hypothesis (Skinner, 2002) posits that each individual discrete task (e.g., math problem) that is part of a larger assignment (work sheet of math problems) can function as a conditioned reinforcer because it has a history of association with, and thus signals, the ultimate positive and/or negative reinforcers associated with assignment completion (e.g., praise, rewards, escape in the form of task completion, avoidance of aversive stimuli for non-completion). Thus, the stimuli associated with completion of each individual discrete task not only serve as reinforcers, they also function as discriminative stimuli for beginning the next discrete task, then the next, etc., until the assignment is completed. This is akin to the relationships between the individual links in a chained task such as tying one's shoes.

Essentially, and in sum, the above conceptualizations posit that the likelihood of engaging in a target response is determined by reinforcement histories, stimulus properties, and discriminations within contexts, including (a) the reinforcement history of the target response in the presence of associated discriminative stimuli, (b) the reinforcement histories associated with subsequent mastered (maintenance) responses and, in general, task completion, (c) the difficulty/ aversiveness of the target response and related stimuli, and (d) the likelihood that the individual discriminates the temporal sequencing of target and mastered skills such that requests for low-p behavior signal an opportunity for reinforcement (i.e., opportunity to engage in a mastered skill or

to escape via task completion). Future research should manipulate arrangements of these variables in order to enhance the effectiveness of IP and evaluate the construct validity of the aforementioned.

Review of the Experimental IP Literature

Method

To identify data-based studies that used IP with individuals with disabilities, a computer-based search was implemented using the data bases Academic Search Complete, ERIC, and EBSCO Host. Search terms included combinations of "behavior management," "interspersal," "academic task difficulty," "behavioral momentum," "high-preference strategy," and "high-probability request sequences." There were no limitations placed on search dates.

Selection criteria. The initial search yielded 932 publications. These were visually inspected for relevance to exceptionalities, yielding a pool of 107 data-based studies. Each study was further evaluated according to the following criteria: The study was data-based and published in a peer-reviewed journal; the study examined use of IP (including other terms for the procedures as given in the introduction) as a primary intervention; and the article was written in English. Application of these criteria yielded 37 relevant data-based studies. An ancestral search of each study was also conducted according to the same criteria. Thirteen more studies were identified by this method, for a total of 50 studies.

The studies described below have been organized within four dependent measure categories that emerged during the review process. Twenty-two of the studies primarily evaluated the effectiveness of IP on academic or functional skills. Five studies reported perceptions of, and/or preference for, IP in conjunction with academic performance. Seventeen studies targeted students' compliance to task requests. Six studies targeted on-task alone or in combination with academic performance. Table 1 displays summary information for the 50 studies, and is organized by these four dependent measure categories. Within each category the studies are organized by publication date to maintain an historical perspective.

Description of Experimental IP Literature

Academic and functional skills. Many students with disabilities exhibit deficits in math computations, reasoning, concept formation, decoding and reading fluency, reading comprehension, spelling, and written composition (Baker, Gersten, & Lee, 2002; Gilbertson, Duhon, Witt, & Dufrene, 2008; Mason & Hagaman, 2012). Students with disabilities may also exhibit functional skills deficits in self-care, independent living and vocational skills (Cuvo, Davis, & Gluck 1991).

Numerous studies have investigated the effectiveness of IP on academic/ functional skills acquisition. Most recently, Burns and Boice (2009) used an alternating treatments design with three conditions (control, and two conditions of various IP scheduling) to measure the effectiveness of IP on participants' retention of word learning. Participants in the study were seventh and eighth grade students with specific learning disabilities (SLD) (n = 10), or with intellectual disabilities (ID) (n = 10).

TABLE 1.
Descriptors of Data-Based IP Studies for Learners with Disabilities Organized by Dependent Variable Category

Reference	Participants	Disability	Dependent Variable(s)	Independent Variable(s)	Research Design	Results
Academic/Functional Skill Training						
Neef, Iwata, and Page (1977)	• N = 6 • Age: 14 - 23 years	• ID	• Acquisition and retention of target spelling and reading sightwords	• IP: ten maintenance items with ten target items • High-density reinforcement	• Multi-element design: concurrent conditions	• Acquisition/retention of spelling and sightwords increased during IP training
Dunlap (1984)	• N = 5 • Age: 4 – 10 years	• ASD	• Rate of task acquisition: trials to criterion (e.g., spelling, matching items, imitation) • Levels of affect	• Three conditions: constant (one target task per session), varied (ten target tasks per session), IP (five target to five maintenance)	• Simultaneous-treatments design	• Trials to criterion was more efficient during IP • Measurements of affect was most positive during IP
Rowan and Pear (1985)	• N = 3 Age: 7 – 11 years	• DS – 1 • ID/ASD – 2	Acquisition, retention, and generalization of picture naming	• IP: one target picture alternated with maintenance pictures • Concurrent procedure: use of only target pictures	ABA design with counterbalancing (BAB)	• Naming responses increased more rapidly during IP • No difference between procedures in percentage of learned items or generalization

Note. ASD = Autism; DS = Down Syndrome; ID = Intellectual Disability; IP = Interspersal Procedures

Koegel and Koegel (1986)	• N = 1 • Age: 8 years	• OHI	• Percent correct of unprompted responses on academic tasks (spelling, reading, word finding) • Ratings of affect	• IP: maintenance tasks mixed with target tasks	• Multiple-baseline design	• Percent correct improved during IP across all tasks • High levels of positive affect demonstrated during IP
Weber and Thrope (1989)	• N = 28 • Age: 10 – 14 years	• ASD – 12 • ID - 16	• Acquisition of gross motor skills in a physical education setting	• IP: three maintenance motor tasks with six target motor tasks	• Pretest-posttest • Constant task and IP conditions	• Greater gross motor skill acquisition demonstrated during IP
Cuvo, Davis and Gluck (1991)	• N = 20 • Age: 16 – 35 years	• ID – 11 • PSN – 1 • SLD – 6 • SLD/MD - 1 • ID/EBD – 1	• Percentage of correct problems on pre—post- and follow-up tests on functional math skills	• Self-paced instruction workbooks: with cumulative or IP format	• Two-factor mixed design with one repeated measure	• Both tasks, cumulative and IP, produced comparable improvements in performance from pre-test to post-test
Charlop, Kurtz, and Milstein (1992)	• N = 5 • Age: 4 - 6 years	• ASD	• Acquisition of target tasks (e.g., “place next to…,” discriminating left/right)	• IP: maintenance tasks with target tasks • Reinforcement: (social reinforcement/praise or primary reinforcers)	• Multiple-baseline design across participants • Three conditions of reinforcement	• Target task performance met criterion when IP was in effect, yet only when maintenance tasks were reinforced with praise
Davis, Brady, Hamilton, McEvoy, and Williams (1994)	• N = 3 • Age: 5 – 6 years	• ASD/ ID/ SLI	• Number of responses to requests to initiate peer interactions	• Five maintenance requests to one target request	Multiple-baseline across participants	• Participants’ increased responsiveness to initiate social interactions

Note. ASD = Autism; EBD = Emotional/Behavioral Disorder; ID = Intellectual Disability; MD = Myotonic Dystrophy PSN = Psychoneurosis; SLD = Specific Learning Disability; SLI = Speech and Language Impairment; IP = Interspersal Procedures

Sanchez-Fort, Brady, and Davis (1995)	• N = 2 • Age: 4 - 8 Years	• WHS –1 • DS –1	• Number of independent target communication requests	• Three to five maintenance requests prior to target requests	• Multiple baseline across behaviors for each participant	• Participants' number of target requests increased
Browder and Shear (1996)	• N = 3 • Age: 12 – 16 years	• ID/EBD	• Correct reading of target sight words • Generalization of word reading to newspaper weather reports	• IP: maintenance words interspersed with10 target words • 5-step error correction	• Multiple probe across participants	• All participants learned the target words • Participants demonstrated maintenance, yet generalization was minimal
Davis, Reichle, Southard, and Johnston (1998)	• N = 2 • Age = 14 - 15 years	• DS –1 • CP -1	• Number of responses to target utterances of communication partners	• IP: maintenance utterances issued prior to one target utterance	• Multiple baseline design across partners	• IP resulted in increased communicative responding to utterances from partners
Burns, Dean, and Foley (2004)	• N = 20 • Age: 3rd - 4th grade	• SLD	• Reading fluency (CWPM) and comprehension	• IP: Instruction prior to reading passages using eleven target words and nine maintenance words	• A-B Design	• Increases in both fluency and comprehension were observed following the IP instruction
Burns (2005)	• N = 3 • Age: 8 years	• SLD	• Single-digit multiplication fluency	• Incremental Rehearsal: 10% target facts and 90% maintenance facts	• Multiple-baseline design across participants	• IR increased the fluency of single-digit multiplication facts of all participants
Burns and Kimosh (2005)	• N = 2 • Age: 19 - 21 years	• ID	• Fluency of functional word reading	• IP: drill-and practice model using 90% maintenance words, 10% target words	• Multiple-baseline design across participants	• Fluency increased by fifteen words per minute for each participant

Note. CP = Cerebral Palsy; DS = Down Syndrome; EBD = Emotional/Behavioral Disorder; ID = Intellectual Disability; IP = Interspersal Procedures; IR = Incremental Rehearsal; SLD = Specific Learning Disability; WHS = Wolf-Hirshorn Syndrome

Chong and Carr (2005)	• N = 3 • Age: 3 - 7 years	• ASD	• Acquisition of motor and vocal tasks	• IP: Maintenance tasks mixed with target tasks • Reinforcement	• A-B design within and across participants	• Participants met mastery criterion for target tasks when all tasks were reinforced
Lee, Stansbery, Kubina, and Wannarka (2005)	• N = 3 • Age: 10 – 11 years	• 1 – ID • 2- SLD	• Acquisition of multiplication facts • Instructional efficiency	• IP: maintenance items mixed with target items • Explicit instruction	• Parallel treatments design	• No differences in acquisition between treatments • IP sessions took twice as long
Patel et al., (2006)	• N = 3 • Age: 2 – 6 years	• DD/FD	• Frequency of food acceptance • Frequency of inappropriate behaviors	• Escape extinction • IP: three high preference food items to one target food item	• Reversal/multi-element design	• Food acceptance increased during IP for two participants • IP plus extinction resulted in fewer inappropriate behaviors
Jung, Sainato, and Davis (2008)	• N = 3 • Age: 5 – 6 years	• ASD	• Percentage of compliance to target task requests • Number of social interactions and disruptive behaviors	• IP: Maintenance requests prior to target requests • Peer modeling	• Multiple-baseline across participants	• Participants' compliance and social interactions increased • Disruptive behaviors decreased
Volkert, Lerman, Trosclair, Addison, and Kodak (2008)	• N = 5 • Age: 4 – 6 years	• ASD – 4 • DD/LAD-1	• Number of independently labeled objects	• IP: 10 target tasks to 10 maintenance tasks • Reinforcer assessment • High-quality or low-quality reinforcement	• Multi-element and multiple baseline designs	• No change in rate of acquisition in IP conditions compared to control • No benefit to IP when maintenance reinforcers used

Note. ASD = Autism; DD = Developmental Delay; FD = Feeding Disorder; ID = Intellectual Disability; IP = Interspersal Procedures; LAD = Language Delay; SLD = Specific Learning Disability

Burns and Boice (2009)	• N = 20 • Age: 7th - 8th grade	• 10 –SLD • 10 – ID	• Acquisition of words from the Esperanto Word List	• IP: three maintenance words to one target word • Incremental Rehearsal: one target word with nine maintenance words	• Alternating treatments design • Three conditions (control, IP, IR)	• Number of words retained from IR was highest • Students retained more words in IP and IR conditions then control condition
Ormsby and Belfiore (2009)	• N = 5 • Age: 4 – 6 years	• ASD	• Percentage of correct independent object labels	• Interspersal of mastered tasks, primary reinforcers, and social praise	• Multiple-baseline, alternating treatments design	• No benefit observed for using IP when highly preferred food and praise reinforcers used
Academic Performance and Perceptions of Task Difficulty						
Neef, Iwata, and Page (1980)	• N = 3 • Age: 19 - 24 years	• ID – 2 • Deaf - 1	• Acquisition and retention of spelling words • Student task preference	• IP: ten maintenance words mixed with ten target words • High-density reinforcement condition	• Multi-element design	• High-density reinforcement increased performance, but IP yielded highest rates of acquisition and retention • Students preferred IP
Cooke, Guzaukas, Presley, and Kerr (1993)	• N = 10 • E1- Age: 14 – 17 years • E2– Age: 9 – 11 years • E3– Age: 9 – 11 years	• E1: EBD • E2: SLD • E3: SLD/ID	• E1: Spelling acquisition and efficiency • E2: Multiplication fluency • E3: Reading fluency	• IP: 30% target items/70% maintenance items • Control: 100% target items	• Within-subjects design	• E1: Control condition more efficient, but participants preferred IP • E2: Higher fluency was reached during IP • E3: More words learned per session during control

Note. ASD = Autism; E1 = Experiment 1; E2 = Experiment 2; E3 = Experiment 3; EBD = Emotional/Behavioral Disorder; ID = Intellectual Disability; SLD = Specific Learning Disability; IP = Interspersal Procedures; IR = Incremental Rehearsal

Cooke and Reichard (1996)	• N = 6 • 6th Grade: • Age: 10 – 12 years	• SLD – 5 • EBD - 1	• Acquisition of multiplication and division facts • Participant preferences for conditions	• Three IP ratios: - 30% target to 70'% maintenance - 50'%, target to 50% maintenance - 70% target to 30% maintenance	• No experimental design: counter-balanced conditions	• Five participants mastered facts faster in the 70%-30% condition • 50% of participants preferred IP condition in which they showed fastest acquisition
Teeple and Skinner (2004)	• N = 32 • Age: 12 – 17 years	• EBD	• Total language arts items completed • Student preference of assignment type	• Grammar assignments with maintenance items and target items	• Within-groups design	• Completion rates were higher on the IP assignment • Most participants preferred the IP assignment
Wildmon, Skinner, Watson, and Garrett (2004)	• N = 39 Age: 7th and 8th Grade	SLD	• Total math problems completed • Number of target math problems completed • Participants' assignment preference	• IP: assignments containing fifteen target items and five maintenance items • Control assignments with all target items	• Within-subjects design	• Target problem completion rates and accuracy levels did not differ across assignments • Participants completed more problems on IP assignment • Participants preferred IP
Compliance						
Singer, Singer, and Horner (1987)	• N = 4 • Age: 7 – 10 years	• DS – 2 • ID/FAS – 1 • TS - 1	• Frequency of compliance to teacher requests	• IP: maintenance tasks issued prior to target tasks	• ABA and BAB reversal designs	• Participants compliance increased during IP

Note. DS = Down Syndrome; EBD = Emotional/Behavioral Disorder; FAS = Fetal Alcohol Syndrome; ID = Intellectual Disability; IP = Interspersal Procedures; OHI = Other Health Impairment; SLD = Specific Learning Disability; TS = Tuberous Sclerosis

Mace et al., (1988)	• 4 • Age: 34 - 45years	• ID	• Percentage of compliance to target requests	• IP: Sequence of three or four maintenance requests to one target request	• Five experiments: E1: multi-element reversal design; E2: A-B-A-B design; E3: multi-element reversal design; E4: multi-element design; E5: multi-element design	• IP resulted in increased compliance
Harchik and Putzier (1990)	• N = 1 • Age = 23	• ID/SZD	• Frequency of taking medication following a request • Frequency of spitting medication out	• IP: five maintenance tasks issued prior to verbal request to take medication • Social/verbal praise • Token economy	• ABAB reversal design	• Frequency of taking medication increased • Frequency of spitting medication out decreased
Mace and Belfiore (1990)	• N = 1 • Age: 38 years	• ID	• Rate of repetitive stereotypy • Percentage of compliance to target task requests	• IP: Three maintenance tasks to one target task	• Multiple schedule design with reversal components	• IP increased compliance • IP decreased stereotypy
Horner, Day, Sprague, O'Brien, and Heathfield (1991)	• N = 3 • Age: 12 – 14 years	• ID	• Percentage of aggression, self-injury, and attempts to complete tasks	• IP condition: maintenance tasks mixed with target tasks	• A-B-A-B-C-B-C-D-E within-subject reversal design	• IP reduced aggression and self-injury, and increased attempts to complete tasks

Note. E1 = Experiment 1; E2 = Experiment 2; E3 = Experiment 3; E4 = Experiment 4; E5 = Experiment 5; ID = Intellectual Disability; IP = Interspersal Procedures; SZD = Seizure Disorder

Zarcone, Iwata, Hughes, and Vollmer (1993)	• N = 1 • Age: 33 years	• ID	• Latency of self-injurious behaviors • Percentage of compliance to instructions	• IP: three maintenance requests to one target request • Escape/extinction	• Multiple schedule design with reversal components	• Extinction combined with IP increased compliance and reduced levels of self-injury • IP alone did not change levels of compliance or self-injury
Ducharme and Worling (1994)	• N = 2 • Age: 5 - 15 years	• ID	• Percentage of compliance to target requests	• IP: three maintenance requests to one target request	• Combined ABAB and multiple baseline design	• IP increased compliance
Houlihan, Jacobson, and Brandon (1994)	• N = 1 • Age: 5 years	• ASD	• Percentage of compliance to target requests	• IP: three maintenance requests followed by a 5- or 20-sec interprompt time prior to a target request	• Alternating treatments design	• IP with shorter interprompt time increased compliance
Zarcone, Iwata, Mazaleski, and Smith (1994)	• N = 2 • Age: 38 - 45 years	• ID	• Percentage of self-injury • Percentage of compliance to target requests	• IP: three maintenance requests to one target request • Escape extinction	• Alternating treatments with a reversal design	• IP treatment alone increased self-injury and decreased compliance • IP paired with extinction decreased self-injury and increased compliance
Kennedy, Itkonen, and Lindquist (1995)	• N = 2 • Age: 18 - 19 years	• "Severe Disabilities"	• Percentage of compliance to target requests	• IP: Four maintenance requests to one target • Four social comments prior to one target request	• Multi-element design	• Both interventions increased compliance, but compliance was higher during IP

Note. ASD = Autism; ID = Intellectual Disabilities; IP = Interspersal Procedures

Davis and Reichle (1996)	• N = 4 • Age: 4 – 5 Years	• EBD	• Percentage of compliance to target requests	• Invariant IP: three consistent maintenance requests to one target • Variant IP: three variable maintenance requests to one target request	• Combined multiple baseline and reversal design	• Initial increase in compliance during invariant IP, but increases were not maintained • Increases in compliance during variant IP were maintained
Mace, Mauro, Boyajian, and Eckert (1997)	• N = 3, Age: 14 - 16 years	• ID	• Frequency of compliance to target requests	• IP: four maintenance requests to one target • Reinforcers for all requests	• ABAB reversal design	• IP paired with primary reinforcers increased compliance
McComas, Wacker, and Cooper (1998)	• N = 1 • Age: 22 months	• DD	• Percentage of compliance to a target medical requests	• DRA/Escape-Extinction • IP/DRA/Escape-Extinction • IP: maintenance requests prior to target requests	• Multiple schedule design	• IP increased compliance above the reinforcement and extinction conditions
Davis, Reichle, and Southard (2000)	• N = 2 • Age: 6 years	• EBD – 1 • DS - 1	• Percent of compliance to target requests	• IP: Three to five maintenance requests to one target request • Preferred item delivered prior to target request	• Alternating treatments design	• IP paired with the preferred item increased compliance
Johns, Skinner, and Nail (2000)	• N = 4 • Age: 16 - 19 years	• SLD	• Time allocation on concurrent computer math assignments	• IP: maintenance items mixed with target items • Control: all target items	• Multiple-baseline nested within an A-B-C-B design	• Participants allocated more time to the IP assignments

Note. DD = Developmental Delay; DS = Down Syndrome; EBD = Emotional/Behavioral Disorder; ID = Intellectual Disability; IP = Interspersal Procedure; SLD = Specific Learning Disability

Wehby and Hollahan (2000)	• N =1 • Age: 13 years	• SLD	• Latency to comply with target requests • Duration of engagement	• Three maintenance requests paired with praise prior to one target request	• ABABACB design	• IP reduced latency to comply • IP minimally increased duration of engagement
Belfiore, Lee, Scheeler, and Klein (2002)	• N = 2 Age: 10 years	• 1 – EBD 1 - SLD	• Latency to initiate target math tasks	• IP: three maintenance items to one target item • Escape condition: ten target items, participants cross off every other item	Alternating treatments design with reversal components	Both conditions decreased students' latency to initiate target tasks
Lee and Lapse (2003)	• N = 4 • Age: 10 – 11 years	• SLD/EBD –1 • TBI – 2 • UND -1	• Number of words written during a 20 min period	• IP: three to five maintenance requests to one target request • IP paired with verbal praise condition	• Alternating treatments design with reversal components	• Both interventions increased the number of words written • IP condition was more efficient
Riviere, Becquet, Peltret, Facon, and Darcheville (2011)	• N = 2 • Age: 6 and 8 years	• ASD	• Percentage of compliance with medical examination request tasks	• IP: three maintenance requests with verbal praise prior to one target request • IP condition with praise delivered following compliance with three maintenance tasks prior to one target request	• ABABCB Design for each participant	• IP increased percentage of compliance to medical examination

Note. ASD = Autism; EBD = Emotional/Behavioral Disorder; IP = Interspersal Procedure; SLD = Specific Learning Disability; TBI = Traumatic Brain Injury; UND= Unspecified Neuro. Disorder

Axelrod and Zank (2012)	• N = 2 • Age: 10 - 11 years	• EBD	• Percentage of compliance to target requests	• IP: Three maintenance requests to one target • Fading: one maintenance request to one target • Maintenance: only target	• Multiple-baseline design across participants with an embedded reversal design	• Increased percentage of compliance demonstrated during IP and fading • Compliance was higher than baseline during maintenance
On-task Alone or in Combination with Academic Performance						
Skinner, Hurst, Teeple, and Meadows (2002)	• N = 4 • Age: 9 – 11 years	• EBD	• Percentage of on-task behavior • Mathematical problem completion rates	• IP: maintenance items mixed with target items • Control: all target items	• Alternating Treatments design	• Participants completed more problems and demonstrated increased on-task during IP
Calderhead, Filter, and Albin (2006)	• N = 2 • Age: 12 - 13 years	• SLD	• Rate of on-task behavior • Percent correct of target math items	• IP: three levels: 0%, 33%, 67% maintenance items	• Alternating treatments design	• IP increased on-task behavior, but did not increase percent of correct items
Koegel, Singh, and Koegel (2010)	• 4 • Age: 4 – 7 years	• ASD	• Latency to begin tasks • Rate of letters written or math problems completed • Frequency of disruptive behavior • Participants interest level	• IP: writing or math assignments with maintenance items mixed with target items • Natural reinforcers during intervention	• Non-concurrent multiple baseline across behaviors and participants	• Latency to begin academic tasks decreased • Rate increased • Interest level increased • Disruptive behaviors decreased
Lee, Lylo, Vostal, and Hua (2012)	• N = 3 • Age: 14 – 18 years	• EBD	• Latency to initiate target math items • Percent of items correct	• IP condition: three maintenance tasks before each target task	• Multiple-baseline design across participants	• IP decreased latency • IP had negligible effects on percent of correct items

Note. ASD = Autism; EBD = Emotional/Behavioral Disorder; IP = Interspersal Procedures; SLD = Specific Learning Disability

Students were taught twenty-seven words from the Esperanto International Word List in the following conditions: (a) drill-and-practice in which nine target words were rehearsed, (b) three target words interspersed with six maintenance words and repeated three times (interspersal), and (c) the rehearsal of unknown words among nine known words so that each new word was rehearsed nine times (incremental rehearsal). Results indicated that the number of words retained from the two IP conditions were much higher (up to three times higher in the incremental rehearsal condition) than the control condition.

Ormsby and Belfiore (2009) investigated the effects of using IP, primary reinforcers, and social praise on the percentage of independent correct labeling of target objects. Participants were primary-age students with autism spectrum disorder (ASD) (n = 5). The researchers indicated that no benefit was observed when interspersing mastered tasks with target tasks when highly preferred food items and praise were provided for correct labeling. Suspecting that the aforementioned results were due to ceiling effects when highly-preferred reinforcers were used, the authors conducted a second experiment to test their hypothesis. Results from the follow-up experiment indicated the outcomes of the first experiment were more than likely the result of ceiling effects. The authors reported that IP might have functioned as a motivating operation by increasing the reinforcing value of the consequence for correct responses; however practitioners should be aware that this result might not occur when highly preferred reinforcers are available.

In addition to the two studies described above, other research has demonstrated the effectiveness of IP for academic/functional skills training. The effectiveness of IP has been demonstrated for teaching: spelling words (Neef et al., 1977), reading sightwords (Browder & Shear, 1996; Burns & Kimosh, 2005; Koegel & Koegel, 1986), matching skills and imitation (Dunlap, 1984), picture naming (Rowan & Pear, 1985), fine/gross motor skills (Chong & Carr, 2005; Weber & Thrope, 1989), functional math skills (Cuvo et al., 1991), discrimination of prepositional phrases (Charlop et al., 1992), social interactions (Davis et al., 1994; Jung et al., 2008), communication responses (Davis et al., 1998; Sanchez-Fort et al., 1995), reading fluency and comprehension (Burns et al., 2004), multiplication facts (Burns, 2005; Lee et al., 2005), food acceptance (Patel et al., 2006); object labeling (Volkert et al., 2008). Table 1 summarizes the results of these studies.

Perceptions of academic task difficulty. The studies described below examined not only the effectiveness of IP on participants' academic performance, but also on student perceptions about, or preferences for, tasks with/without IP, as well as tasks with a relatively higher vs. lower ratio of maintenance to target items. Beyond the obvious relationship to social validity, the study of perceptions and preferences related to IP is important because unfavorable student perceptions of assign-ments may lead to less engagement (Billington & Skinner, 2006; Skinner, 2002), i.e., more difficult assignments may produce negatively reinforced escape/avoidance behavior. Studies on time perception, time judgments, and timing suggest that when event rates (i.e., the rate of presentation of stimuli) are increased, the perception of elapsed time is decreased (Bakan, 1955;

Billington & Skinner, 2002; Killeen & Fetterman, 1988; Penton-Voak, Edwards, Percival, & Wearden, 1996; Staddon & Higa, 1999). Essentially, when students are presented with an assignment comprised of multiple discrete items, such as math facts or vocabulary words, the completion of each individual item can be considered an event. By increasing the event rates of interspersed maintenance items (which require less time to complete) without reducing assignment demands (target items, which require relatively more time and effort to complete), perceptions of task difficulty and required effort (both of which may be aversive), as well as perceptions of the time required to complete the assignment, may be altered in such a fashion as to reduce avoidance behavior associated with un-mastered items.

In one of the most recent studies on perceptions related to IP, Teeple and Skinner (2004) used a within-groups design to evaluate the effectiveness of IP on grammar assignments, including total number of items completed (maintenance and target), total number of target items completed, percentage of sentences copied and accurately punctuated, and students' preferences for type of homework assignment (no IP vs. IP). The participants were seventh grade students with EBD (n = 32). Results indicated that the rate of discrete task completion (rate of paragraph completion) was significantly higher for the interspersal condition. Further, significantly more participants chose the interspersal grammar assignment for homework.

Wildmon et al. (2004) used a within-subjects design to compare participants' mathematics performance (total number of items completed, number of target items completed, percentage of target items completed accurately) across assignments. In addition, researchers analyzed students' choice and ranking data (perception of time, effort, difficulty, and homework assignment selection) following exposure to assign--ments. Participants were seventh and eighth graders with SLD in mathematics (n = 39). Control assignments contained fifteen target items (four-digit minus four-digit computation problems), and the interspersal assignments contained fifteen target items and five additional maintenance items (one-digit minus one-digit computation problems). Results showed that target problem completion rates and accuracy levels did not differ across control and interspersal assignments. However, participants completed significantly more total problems on the interspersal assignment. The authors reported that even though the interspersal assignment contained more items, significantly more participants rated it as requiring less effort to complete and selected it for homework.

In addition to the studies described above, other research has demonstrated the effectiveness of IP on participants' academic performance and perceptions of task difficulty. Specifically, scholars have investigated the effects of IP on students' perceptions of task difficulty in conjunction with acquisition of spelling words (Neef et al., 1980), or math computations (Cooke et al., 1993; Cooke & Reichard, 1996). Table 1 summarizes the results of these studies.

Compliance. Even if students do attain fluency in performing a skill, their levels of achievement will likely diminish over time unless they receive opportunities to practice the skill at regular intervals. Repeated failures may produce problematic behaviors that are maintained by escape or avoidance, such as non-compliance and aggression. Simply, if a student's lack of engagement is excessive, that student will be less likely to be an active participant in learning activities and processes (Hulac &

Benson 2012; Reichle, Drager, & Davis, 2002). Utilization of the IP has been implemented with students who engage in such behaviors.

Riviere et al. (2011) used an ABABCB design to examine the effectiveness of using IP to increase participants' compliance with medical examination tasks. Participants were primary-age children with ASD (n =2) who frequently exhibited noncompliance during general medical examinations. For this study the IP consisted of a series of three maintenance task requests (e.g., clapping hands, simple motor imitations) issued prior to one target task request (e.g., opening mouth for dental examination). Results indicated that the IP effectively increased participants' compliance with target medical examination tasks.

Axelrod and Zank (2012) used a multiple-baseline design across participants, with an embedded reversal design, to evaluate the effects of IP on the percentage of compliance to target tasks. Participants were primary-age students with emotional/ behavioral disorders (EBD) (n = 2). The IP used was a sequence of three maintenance task requests (e.g., giving teacher a high five, putting hands on lap) issued prior to one target task request (e.g., reading a sentence from text, writing name). Results indicated that both participants demonstrated increased levels of compliance during intervention phases.

In addition to the studies described above, other research has examined the effectiveness of IP for increasing participants' compliance to initiate non-preferred tasks. Specifically, scholars have examined the effectiveness of using IP to increase compliance to initiate: math tasks (Belfiore et al., 2002; Johns, Skinner, & Nail, 2000), social interactions (Davis & Reichle, 1996), classroom transitions (Davis et al., 2000), hygiene tasks (Ducharne & Worling, 1994), oral consumption of medication (Harchick & Putzier, 1990), various instructional tasks (Horner et al., 1991; Houlihan et al., 1994; Kennedy, Itkonen, & Lindquist, 1995; Singer et al., 1987; Wehby & Hollahan, 2000), writing tasks (Lee & Lapse, 2003), various daily living tasks (Mace & Belfiore, 1990; Mace et al., 1988; Mace et al., 1997; Zarcone et al., 1993; Zarcone et al., 1994), various medical procedures (McComas et al., 1998). Table 1 summarizes the results of these studies.

On task alone or in combination with academic performance. During instruction in fundamental academic concepts, many students with disabilities have difficulty remaining engaged with instructional content long enough to master the skill being taught and to practice it independently (Gickling & Armstrong, 1978; Gilbertson, Duhon, Witt, & Dufrene, 2008; Hulac & Benson, 2012). Although the effectiveness of IP in increasing student engagement has been demonstrated, this alone is inadequate if concomitant gains in academic performance are not observed. The articles reviewed below examined the effects of IP interventions on both on-task behaviors and skill acquisition of learners with disabilities.

Koegel et al. (2010) used a multiple baseline across participants and behaviors design to measure the effectiveness of using IP and other motivational components (e.g., student choice of assignment) on the latency, rate of completion per minute, percentage of disruptive behavior, and student interest in math or writing assignments. Participants in this study were a preschool student (n = 1) and primary age students (n = 3) with ASD. The IP for writing tasks involved interspersing maintenance items (e.g., writing a single letter) among target items (e.g., write multiple sentences). Similarly, the IP for math tasks involved

interspersing maintenance items (single-digit computation problems) among target items (two-digit computation problems). The authors did not specify the ratio of target to maintenance items; yet, it was indicated the number of maintenance and target items were held constant in each phase. Results indicated that the intervention package (IP in conjunction with the motivational components) decreased participants' latency to begin academic tasks, increased rate of performance, increased interest, and decreased disruptive behaviors.

Lee et al. (2012) used a multiple baseline design across participants to evaluate the effectiveness of using IP to decrease latency to initiate target tasks, and to increase the percent of target items completed correctly. Participants were secondary students with EBD (n = 3), and the IP involved worksheets with three maintenance items (single-digit math computation problems) preceding one target item (multi-digit math computation problems). Results indicated that the IP resulted in a slight increase in percent of problems correct and a substantial decrease in latency to initiate target items for all participants.

In addition to the two studies described above, other research has demonstrated he effectiveness of IP in increasing participants' time on task and academic performance. Specifically, scholars have investigated the effects of IP on participants' time on-task in conjunction with math computation (Calderhead, Filter, & Albin, 2006; Skinner et al., 2002) and letter writing (Koegel et al., 2010). Table 1 summarizes the results of these studies.

Summary and Analysis of IP Research

The overall effectiveness of IP in facilitating skill acquisition and in favorably affecting perceptions of tasks is evident. Ninety-four percent (47/50) of the studies found IP, alone or in a treatment package, to be effective. Of the 50 studies analyzed, 54% (27) isolated the effects of IP, i.e., no other treatment variables were present (Axelrod & Zank 2012; Burns, 2005; Burns & Boice 2009; Burns et al., 2004; Burns & Kimosh 2005; Calderhead et al., 2006; Davis & Reichle 1996; Davis et al., 1998; Ducharme & Worling 1994; Dunlap 1984; Horner et al., 1991; Johns, Skinner, & Nail, 2000; oegel & Koegel 1986; Koegel, Singh, & Koegel, 2010; Lee, Lylo, Vostal, & Hua, 2012; Mace & Belfiore, 1990; Mace et al., 1988; Neef et al., 1977; Neef et al., 1980; Rowan & Pear 1985; Sanchez-Fort, Brady, & Davis, 1995; Singer et al., 1987; Skinner et al., 2002; Wildmon et al., 2004; Teeple & Skinner 2004; Weber & Thrope 1989; Wehby & Hollahan 2000). Fifteen studies indicated that IP facilitated therapeutic behavior change when used in conjunction with other independent variables (e.g., escape extinction, primary reinforcers) in an intervention package (Browder & Shear 1996; Charlop et al., 1992; Chong & Carr 2005; Cooke & Reichard 1996; Davis et al., 1994; Davis, Reichle, & Southard, 2000; Harchik & Putzier 1990; Houlihan, Jacobson, & Brandon, 1994; Jung, Sainato, & Davis, 2008; Mace, Mauro, Boyajian, & Eckert, 1997; McComas, Wacker, & Cooper, 1998; Ormsby & Belfiore 2009; Patel et al. 2006; Zarcone et al., 1993; Zarcone, Iwata, Mazaleski, & Smith, 1994), and five studies found IP was commensurate with, but not superior to, other contrasted instructional procedures (Belfiore et al., 2002; Cuvo et al., 1991; Kennedy, Itkonen, & Lindquist, 1995; Lee & Lapse 2003; Riviere et al., 2011).

Limitations

Careful analysis of the experimental designs and procedures indicated that almost half of the studies did not isolate the effects of IP (i.e., IP was used in conjunction with other independent variables as part of

a "treatment package"). Thus, while the effectiveness of these packages may have been demonstrated, partitioning of the variance specifically attributable to IP or any other independent variable within a given package, or combinations therein, cannot be accomplished; this is an inherent limitation of treatment packages. Future research should evaluate the relative effectiveness of IP alone versus IP as part of a package, and reference such comparisons to response classes when possible.

Of the 50 studies in this review, 14 (28%) focused primarily on academic content (spelling, math, composition, reading), and four (8%) examined both student engagement and academic and/or functional skill development. Future research should expand to include both student engagement and academic/ functional skill acquisition as standard measures to add perspective to interpretations regarding functions of behavior and efficiency of the procedures.

The majority of studies analyzed included participants with intellectual or learning disabilities in school and clinical settings. Future research should expand to study the effectiveness of IP with students across a range of disabilities/challenges (e.g., emotional and behavioral disabilities, attention deficits), ages and settings (e.g., home, work, community).

Pragmatics and Recommendations

It seems important to ask: Does the extant research identify under what conditions IP is or is not recommended? While the reviewed studies strongly support the efficacy of IP, three (Cooke et al., 1993; Lee et al., 2005; Volkert et al., 2008) specifically compared IP to other instructional sequences (e.g., 100% target items with reinforcement; explicit instruction) and concluded that IP, though effective, may require more time to mastery in some situations than other instructional arrangements. This raises questions for future research as to the efficiency of IP in terms of time management. Do other procedures (e.g., token or differential reinforcement) work as well or better in fewer sessions/less time? If so, at first analysis it might seem that IP would not be recommended given those contexts. However, even if IP proves in some arrangements to be less efficient with respect to the *acquisition* of new skills, the possible advantage associated with IP regarding *maintenance* of mastered items may warrant the additional instructional time (i.e., IP, compared to instruction of only target items, inherently provides the opportunity for intermittent reinforcement of mastered skills that were identified either (a) as maintenance items at the time of screening, and/or (b) as targets that were mastered during the IP intervention and subsequently moved into the pool of interspersed maintenance items. Thus IP has the advantage of increasing the likelihood of generalized responding over time (i.e., maintenance of learned items or skills). Future research that focuses on comparisons of the efficiency (e.g., instructional time to criterion) of IP versus other interventions should reference comparisons to the maintenance of both target and mastered items/skills.

The basis for using IP is primarily motivational. For some individuals, escape/ avoidance behaviors (e.g., noncompliance or off-task) may occur upon presentation of target items and be negatively reinforced. This may occur because of aversive stimuli inherent in, or concurrent with, the target task. For individuals who engage in escape/avoidance behavior, IP is an appropriate strategy because increasing the ratio of maintenance to target items can be expected to reduce the overall aversiveness

of the task. However, if a given learner has evidenced consistent responding to 100% target items with few or no escape/ avoidance behaviors, it may be that there is little to no advantage to using IP with that learner in that arrangement; *at least with respect to efficiency* (i.e., interspersing mastered items decreases the proportion of instructional time on target items). In essence, then, students who are likely to engage in and maintain attention to more challenging tasks may not benefit from IP as a motivational tool (Lee et al., 2005) simply because they are otherwise motivated. Still, a decision to not use IP should first recognize the added benefits that IP offers with respect to maintenance of mastered skills that otherwise might not occur (i.e., if instruction includes only target items). Practitioners may benefit by using functional behavioral analysis (FBA) to identify the strength and function of a learner's approach/escape behaviors exhibited in instructional arrangements to better guide decisions regarding whether to intersperse maintenance items. Future research should also focus on the use of FBA in determining IP ratios of maintenance to target items.

Finally, the terminology related to IP strategies is highly variable. Some of these differences seem to be stylistic, while others represent nuances in focus or advancements that have developed over five decades. IP was selected here as an umbrella term because it is the seminal term (Neef, Iwata, & Page, 1977) in this body of literature and because it inclusively addresses the variety of procedures described herein.

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