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Assessing Behavioral Momentum in Humans with Mental Retardation and Unstable Baselines

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BRIEF REPORT

ASSESSING BEHAVIORAL MOMENTUM IN HUMANS WITH MENTAL RETARDATION AND UNSTABLE BASELINES

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Nevin described behavioral momentum by drawing an analogy between physical motion and behavioral persistence (Nevin, 1992; Nevin & Grace, 2000). In classical mechanics, the degree to which an opposing force will reduce the velocity of a moving body depends upon that body's momentum. Momentum is directly proportional to mass, and thus increasing mass increases resistance to change. Nevin suggested a parallel in the discriminated operant, with rate of responding analogous to velocity. According to the momentum analogy, the degree to which a disrupting event will reduce the rate of a response depends upon the behavioral momentum. Previous research indicates that the momentum of a discriminated operant may be directly related to the rate of reinforcement in the presence of the discriminative stimulus, and thus increasing reinforcer rate may increase behavioral "mass" and resistance to change.

Behavioral momentum is typically assessed by measuring relative disruption in the components of multiple schedules with different obtained reinforcer rates. Disrupters are events that typically reduce response rates, and they may include procedures such as prefeeding, concurrently available alternative reinforcers, extinction, and so forth. Behavioral mass is indexed by the difference in response-rate reductions in the components during disruption, expressed as proportions of baseline rates. A behavioral momentum effect is shown by smaller reductions in the component with the higher reinforcer rate. Thus, typical procedures require a series of baseline sessions with stable response rates followed by one or more sessions with disrupters.

Our laboratory is currently conducting studies of behavioral momentum in humans with mental retardation. A better understanding of momentum effects may contribute to more effective procedures for reducing or eliminating learning problems in this population (e.g., McIlvane & Dube, 2000). In our studies, we have occasionally encountered cases where even liberal baseline stability criteria were not met after a substantial number of sessions, and thus typical procedures for evaluating momentum were not appropriate. This brief report will describe an alternative testing procedure that we are examining for use in these situations. Comments and suggestions from our audience are most welcome.

Subjects and Setting

We will present data for the first two subjects who have received the new testing procedure, Subject KVB (age 20 years, moderate/severe mental retardation), and Subject PGK (age 15 years, moderate mental retardation). Experimental sessions were conducted in a small, quiet room in the subjects' school. Subjects sat alone in the room at a desk with a computer, touchscreen-equipped monitor, and an automated token dispenser (Med ENV-703 poker chip dispenser). The experimenter observed through a small one-way window behind the subject.

Reinforcers

Prior to training, red plastic poker chips were established as conditioned reinforcers. Subjects earned these tokens during experimental sessions and exchanged them after each session for a variety of items such as snack foods, fruit juice, coins, and so forth.

Software

The research software implemented multiple and concurrent schedules in the context of a computer game appropriate for individuals with

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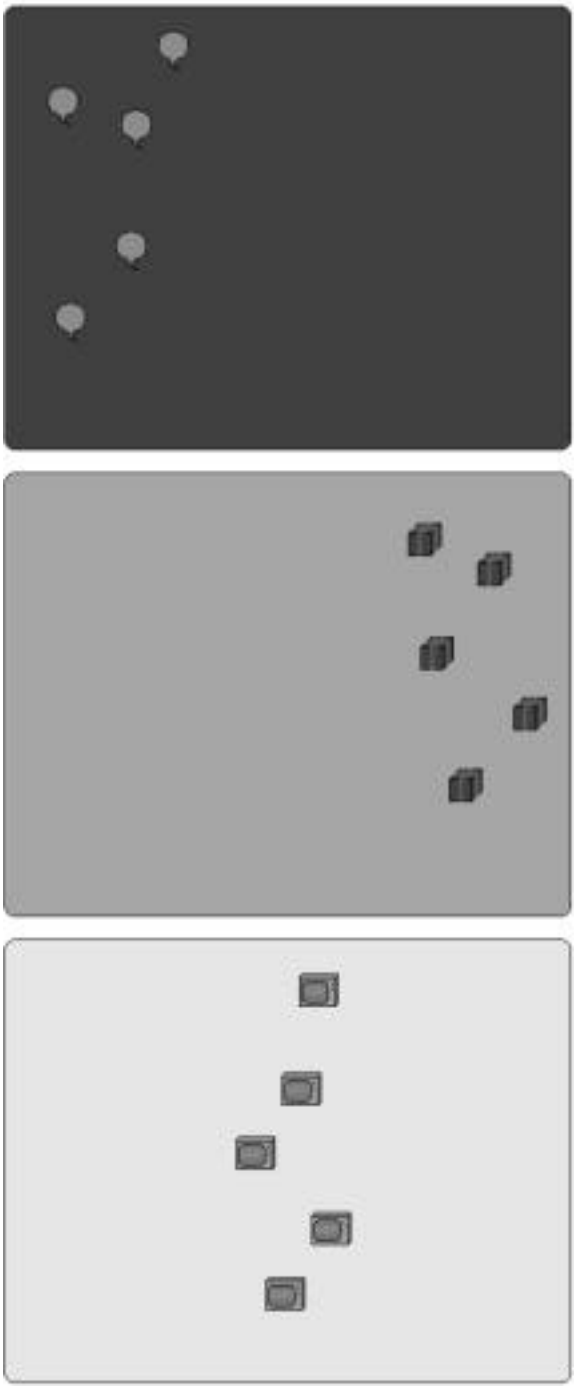

Figure 1

mental retardation. The stimuli were animated 2x2 cm color icons depicting balloons, gifts (wrapped packages), and television sets (TVSets), appearing in the left, right, or middle portions, respectively, of the monitor screen. Different background colors were used for each type of icon, and five identical icons appeared to float around in the designated portion of the screen (see Figure 1). The subject responded by touching the icons. Because the icons were moving, subjects sometimes missed them when responding, but all responses were included when response rates were calculated. Feedback was provided for each hit; the icon disappeared with a soft "pop," and a new icon appeared in a different location. When a reinforcer was scheduled to follow a hit, the icon disappeared with an animated explosion with distinctive sounds. The icon was replaced by an image of a red token that fell to the bottom of the monitor screen (see Figure 2). As the on-screen token disappeared from the screen, a real token was dispensed onto the tabletop. Response-independent tokens were presented in some components; a token image appeared at the top of the screen, fell to the bottom, and a real token was dispensed.

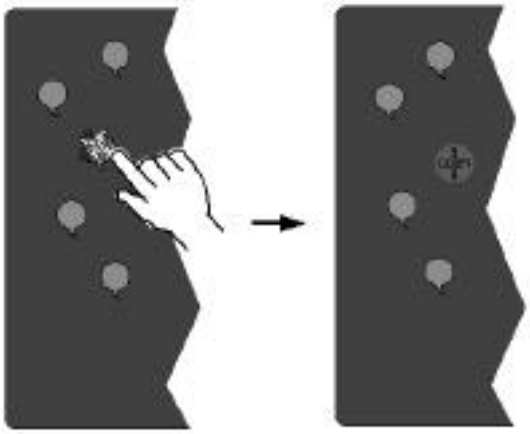

Figure 2

Baseline Conditions

There were two successive baseline conditions, summarized in the upper portions of Table 1. All

Table 1

Order of presentation was counterbalanced across sessions for all components with balloons or gifts.

Baseline 1
3 x 1 min Balloons VI 10 s
3 x 1 min Gifts VI 10 s VT 7 s

Baseline 2
1 min TVSets VI 7 s
2 x 1 min Balloons VI 10 s
2 x 1 min Gifts VI 10 s VT 7 s

Distributed-Sessions Test Procedure
1 min TVSets VI 7 s
1 min Balloons VI 10 s
1 min Gifts VI 10 s VT 7 s
1 min concurrent TVSets VI 7 s Balloons VI 10 s
1 min concurrent TVSets VI 7 s Gifts VI 10 s VT 7 s

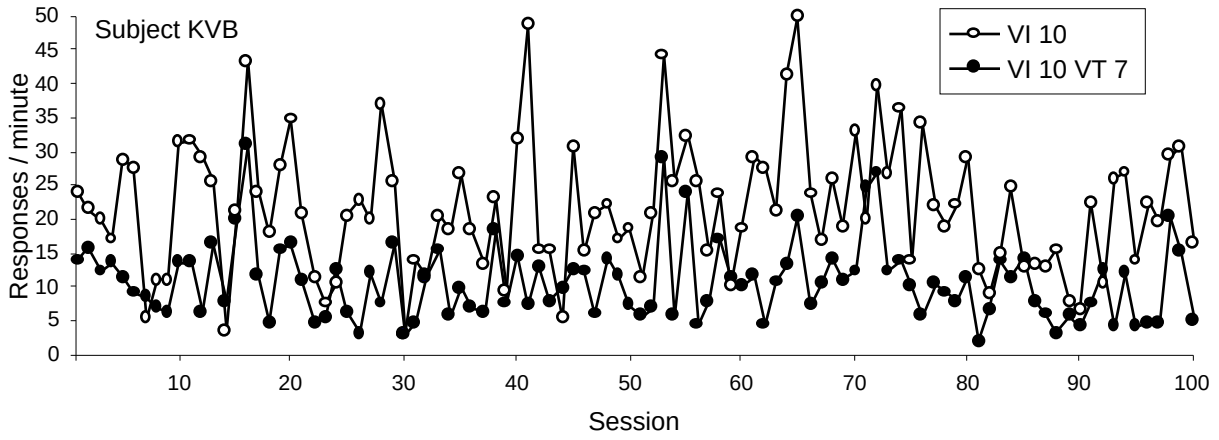

Figure 3

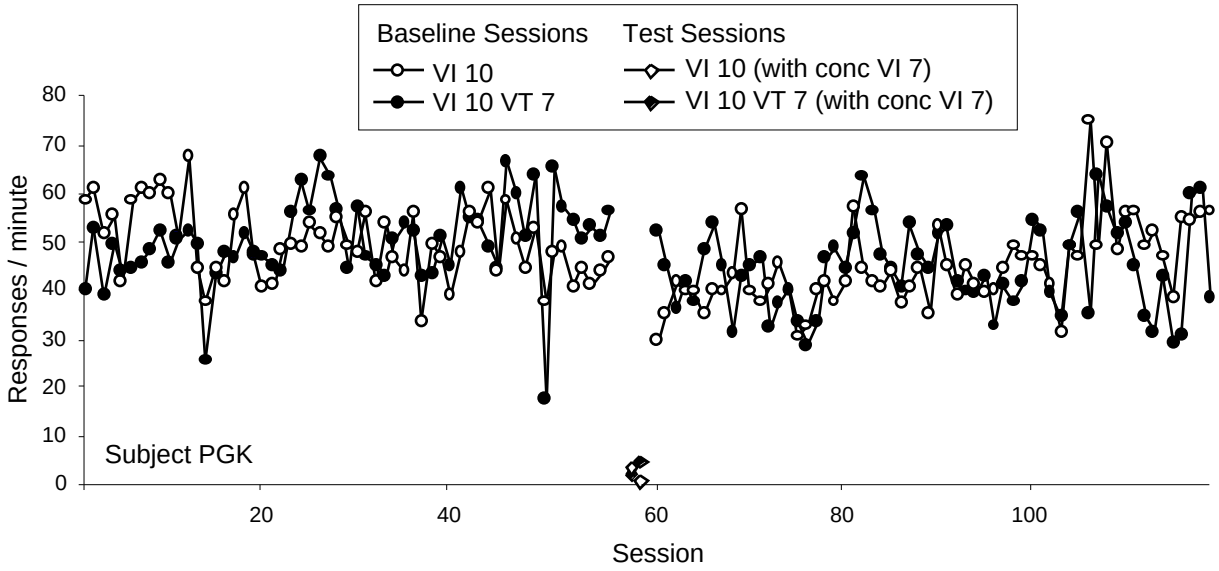

Figure 4

VI schedules had nine values (Fleshler & Hoffman, 1962). *Baseline 1* was a two-component multiple schedule. Balloons were the stimuli for one component, with tokens available on a VI 10 s schedule. Gifts were the stimuli for the other component, with tokens available on a VI 10 s schedule plus response-independent tokens presented on a VT 7 s schedule (similar to Nevin, Tota, Torquato, & Shull, 1990). Sessions consisted of three alternating 1-min periods for each component (total 6 min) with 10 s intercomponent intervals. The stability criterion for completing Baseline 1 and advancing to Baseline 2 was five consecutive sessions in which response rates for each component did not vary by more than 25% from the five-session mean and there was no trend apparent by visual inspection of the data.

Baseline 2 was a three-component multiple schedule. The stimuli for the first 1-min period of each session were TVSets, presented in the middle of the screen, with tokens available on a VI 7 s schedule. The TVSets, which were used as disrupters in subsequent test sessions, were introduced at this point to provide a reinforcement history for responding to them. After the 1-min TVSets period, there followed four alternating 1-min periods with the Baseline-1 stimuli and schedules. The stability criterion for completing Baseline 2 and advancing to momentum test sessions was five consecutive

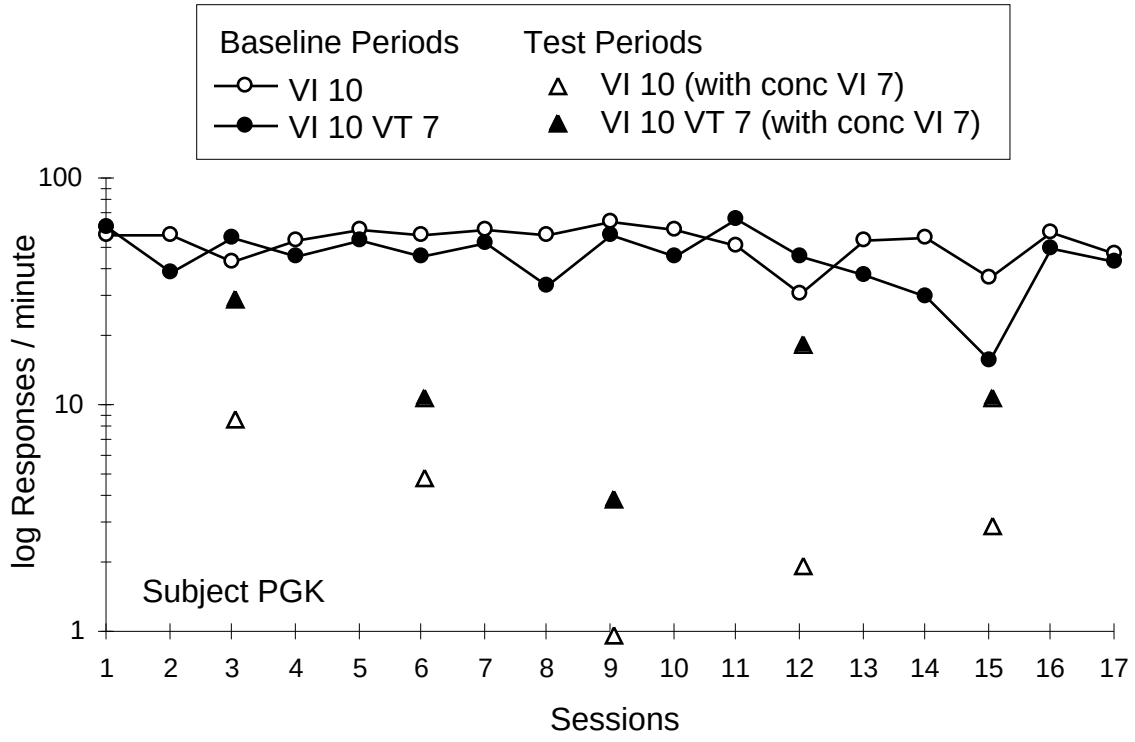

Figure 5

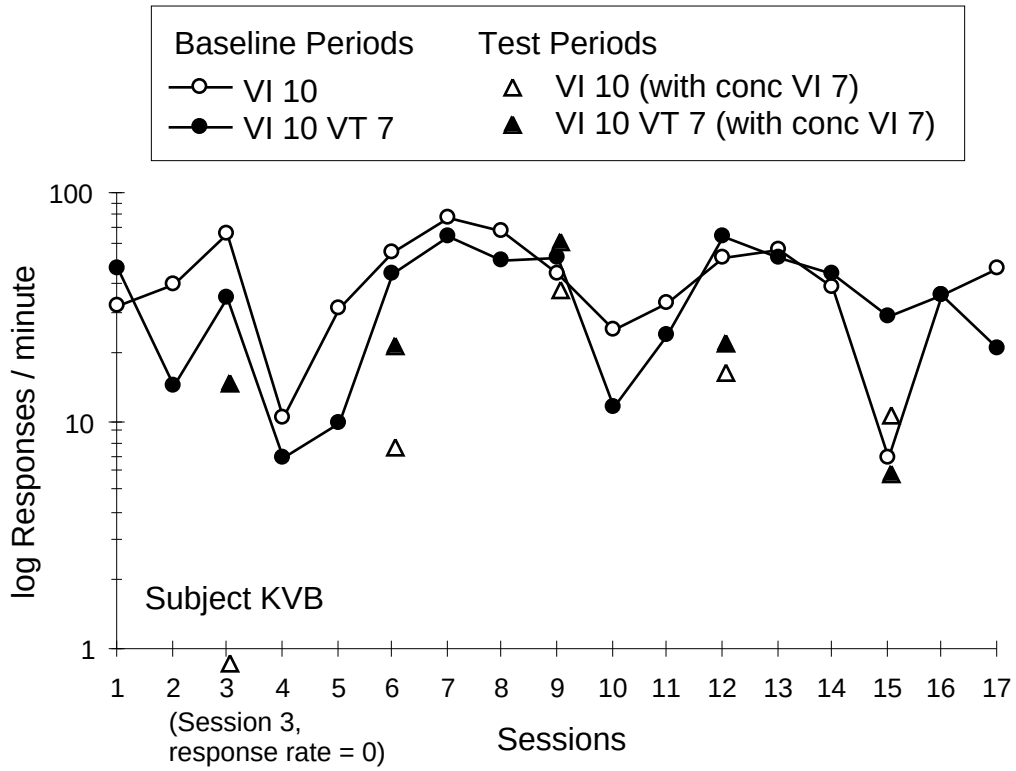

Figure 6

sessions in which response rates for the Balloon and Gift components did not vary from the five-session mean by more than 10% or one standard deviation, whichever was greater, and there was no trend apparent to visual inspection. Because the TVSets were used only as a disrupter, there was no stability criterion for this component.

Consecutive-Sessions Test Procedure

Our plan was to test behavioral momentum in two consecutive disrupter sessions presenting the TVSets as concurrently available alternatives to the Balloons and Gifts. That is, the test sessions would present a multiple schedule with concurrent VI (TVSets) VI (Balloons) in one component, and concurrent VI (TVSets) VI VT (Gifts) in the other component. Two test sessions were necessary to counterbalance the order of component presentation. Momentum would be assessed by comparing response rates for Balloons (VI) and Gifts (VI VT) during the disrupter sessions to the response rates in the last five Baseline-2 sessions before the test. That is, we planned to compare response rates for a set of stable baseline sessions to response rates in immediately following disrupter sessions. The lesser response-rate reduction during disruption would indicate the greater behavioral momentum. Two disrupter tests were planned, with a return to the Baseline-2 condition between the tests (e.g., Mace, Lalli, Shea, Lalli, West, Roberts, & Nevin, 1990).

We were unable to implement the planned test procedure with Subjects KVB and PGK because of unstable baselines. Subject KVB did not meet the Baseline-1 stability criterion in 100 sessions (Figure 3). Subject PGK met the Baseline-1 criterion in 10 sessions and the first Baseline-2 criterion in 57 sessions (Figure 4). In his first consecutive-sessions momentum test, response rates in both components fell to very low rates, 6% of baseline in the VI component, and 7% of baseline in the VI VT component (Figure 4). When Baseline-2 sessions resumed after the first test, Subject PGK then failed to meet the stability criterion within another 60 sessions (Figure 4).

Distributed-Sessions Test Procedure

We modified the momentum test procedure to accommodate the session-to-session fluctuations in baseline response rates. Baseline-2 sessions continued and, in every third session, the disrupter was presented during the last 1-min period of each component. An example is shown in the bottom portion of Table 1. Response-rate reductions during the disrupter periods were measured relative to the earlier baseline rates for the same component, within the same session. Each subject was given 5 tests distributed over 17 sessions. (Because of a programming error, Subject KVB initially received 8 test sessions in which no tokens were delivered for responses to the disrupter stimuli during the test periods. Summed test-period data for these sessions show that there was no disruption. Response rates for the VI and VI VT components were 105% and 106% of baseline, respectively. These data are not included below.)

Figures 5 and 6 show log response rates for the Balloon and Gift components in both baseline and test sessions for Subjects PGK and KVB, respectively. The data were consistent with momentum effects for both subjects, although baseline response rates continued to vary from session to session (when evaluating variability, note that the ordinates are linear in Figures 3 and 4, and logarithmic in Figures 5 and 6). In nine of the ten test sessions, the within-session test/baseline response rates were lower in the VI component than in the VI VT component. The only exception was KVB, Session 15 (Figure 6). KVB's data are somewhat inconclusive for Sessions 9 and 15 because response rates increased during one of the disrupter periods in each of these sessions. Although the momentum analysis seems equally applicable to both behavioral acceleration and deceleration, some caution is warranted because the disrupter procedure did not have the predicted effect.

Figure 7 shows log test/baseline for data summed over the five tests for each subject and, for KVB, summed data with Sessions 9 and 15 omitted. For both subjects, the decrease was greater in the VI component than in the VI VT component.

The distributed test procedure is analogous to the approach used in electrophysiology, where the problem of low signal-to-noise ratios is addressed by gathering data over a series of distributed measurements. If the procedure proves to be reliable and replicable, it may offer a useful addition to the toolbox for translational laboratory research with humans in clinical/educational settings, where control over establishing operations and related variables may be limited.

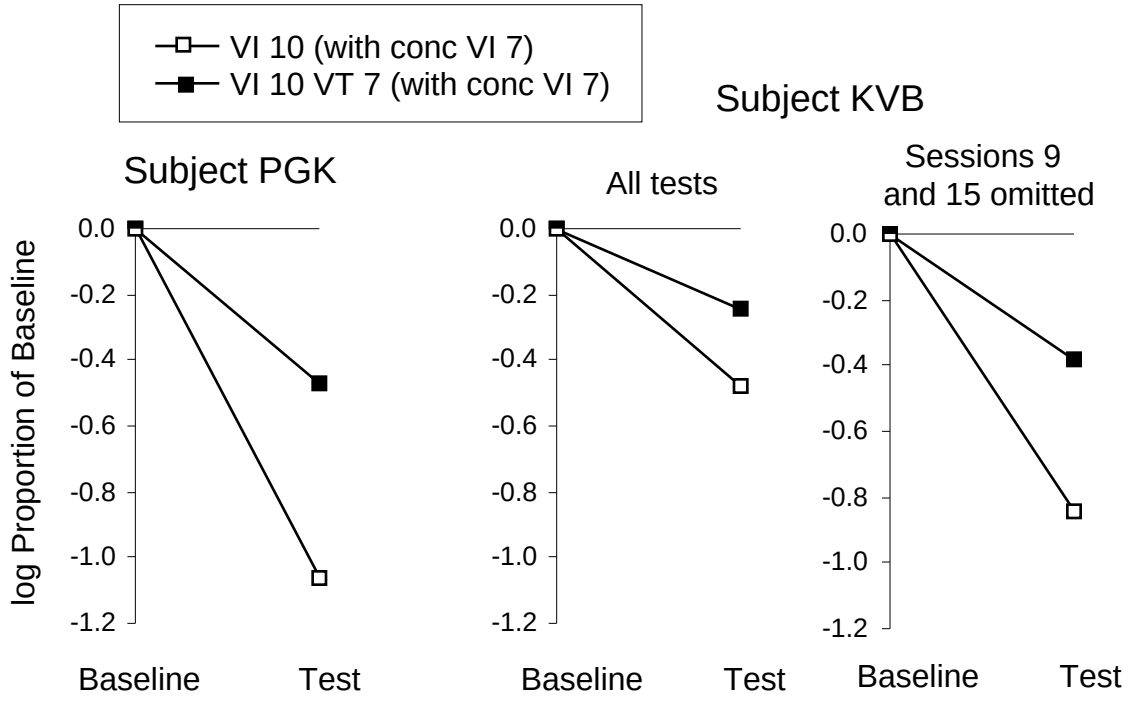

Figure 7

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