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ARTICLE



## The allocation of playing behavior of children in mainstream day care according to social reinforcer ratios

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### ABSTRACT

Previous works on the generalized matching law in natural settings studied behavioral patterns of participants having developmental disabilities. From a translational view (applying findings from basic science to applied research and reciprocally), it is of interest to evaluate the sensitivity of typical behavior to reinforcement among typical children. In the current study, we examined the relationship between children's naturally occurring rate of play behaviors and rate of social reinforcers awarded by their educator and peers. Three typical children's behaviors were observed via descriptive analyses in their usual day care room during periods of free play. Results show that the generalized matching law explained 94%, 73%, and 90% of the variance of the relation between behavior and reinforcer rate ratios and that children's behaviors were sensitive to social attention (sensitivity of .88, .67, and .87). Allocation of playing behaviors of typical preschool children followed the matching law predictions. The natural variability of response and reinforcer rates (their unpredictability) within natural settings is discussed. We suggest that there may be no need in natural settings to wait for the operant to reach a steady state as long as participants have been consistently behaving in the contingencies of reinforcement.

### ARTICLE HISTORY

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The generalized matching law (GML) is a quantitative model that describes an organism's response allocation as a function of reinforcer ratio (Baum, 1974). This relation is expressed by the following equation:

$$\log(B_1/B_2) = a \log(R_1/R_2) + \log(c)$$

where  $B_1$  and  $B_2$  correspond to response rates and  $R_1$  and  $R_2$  correspond to reinforcer rates. The coefficient  $a$  is referred to as the sensitivity of the organism to the contingencies and the intercept  $\log(c)$  is referred to as the bias for a given response in the absence of reinforcer.

The robustness of the GML has already been demonstrated under tight and specific experimental conditions (Davison & McCarthy, 1988; McDowell, 2013) and has been successfully used as a tool to analyze behavior–environment relations occurring in natural settings (see Rivard, Forget, Kerr, & Bégin, 2014). The GML was seen in the 1980s as a

promising framework to assess the relations between behaviors and their associated reinforcers because it provides two substantial contributions to the evaluation and treatment of problem behaviors (McDowell, 1981). First, the GML conceptualizes several behaviors and reinforcers fostering the understanding of behavior–environment relations. Second, the GML implies that the frequency of behavior does not only depend on the absolute rate of reinforcement but also on the relative rate of reinforcement of the schedule.

More recently, studies in natural settings have shown that the GML describes several problem behaviors (e.g., self-injurious behavior, aggression, or property destruction) according to multiple reinforcers (e.g., attention, escape, or tangible item). Moreover, most studies evaluating the GML in natural settings were concerned with participants having developmental disabilities or showing problem behavior (Rivard et al., 2014; St. Peter et al., 2005). From a translational standpoint, that is, studying the everyday relevance of behavior principles and innovating through synthesis of basic and applied science (Mace & Critchfield, 2010), it would be interesting to evaluate the generality of the GML with typical children and naturally occurring behaviors in school setting. Thus, we examined the relation between play behaviors of three children with typical development in a day care center according to the ratio of naturally occurring social reinforcers from their educator and peers.

## Method

### *Participants, setting, and data collection*

Participants were chosen according to a functional assessment interview inspired by Sattler (2002) and O’Neill, Horner, Albin, and Sprague (1997). The interview carried out with the educator identified three children demonstrating behavior which were likely to be reinforced by social attention (the educator took care of 10 children). Eloi, John, and Math were three typically developing children aged from 4 to 5 years attending a mainstream day care center. The interview confirmed that they presented no problem behavior or known diagnosis.

Direct observation took place in the room children usually stay in during free play. The room contained chairs, tables, as well as many toys, and games. During the observation sessions, four to nine other children (including other target children), the educator, and one or two observers were present. Descriptive analyses were conducted using a procedure inspired by Rivard et al. (2014). Observers collected data manually (paper and pencils) using a momentary time sampling method instead of camera recording, because of the ethical obligation of getting all parents’ agreement in a setting involving many children. For each session, a single child’s behavior was the target of the observation while all other children were considered possible sources of reinforcement. Target behaviors and reinforcers were observed during fixed 5-s intervals of observation followed by 5 s of recording. The 5-s interval was signaled by a discrete earphone that only observers could hear. Sessions lasted 9 min. Eloi, Math, and John were observed over a period of 2 months during 240, 198, and 180 min (corresponding to 27, 21, and 19 sessions).

### Target behavior

A trained experimenter observed participants' responses and associated social reinforcers according to an adapted version of Forget's (1981) scale. Playing was the target for all three children. Any interval of 5 s in which the child was either playing or speaking with a toy, laughing, telling a story, playfully throwing a toy was compiled as an occurrence of the target behavior ( $B_1$ ). The operational definition of playing behavior was inspired by the functional assessment interview with the educator. Specifically, it was observing or looking at a toy for at least 3 s; laughing (when appropriate); cheating during a game or an activity; throwing a toy during gameplay (not targeting other children); speaking about a game with another child or adult, acting with dolls; saying words loudly during gameplay (not yelling at someone); singing for at least 3 s. Any 5-s interval in which no target behavior occurred was entered as other behavior ( $B_2$ ) and was recorded according to its topography. For instance, children's behavior could be classified as moving (e.g., leaving the place, walking in the room), disturbing peers (e.g., interrupting, bothering, hitting, or pushing someone), making noise (e.g., with an object or a body part), being attentive to the task (e.g., following a demand), commenting or emitting vocal noise (e.g., repeating vocalizations, screaming, calling someone), chatting with someone, or self-stimulating (e.g., touching his body or clothes).

Consequences from peers and the educator consisted of giving a tangible item, speaking, touching, or specifically watching the participant. They were considered contiguous with a behavior when it was presented in the same 5-s interval ( $R_1$ , reinforcer rate for play behavior, or  $R_2$ , reinforcer rate for other behavior).

### Interobserver agreement

Interobserver agreement was carried out during 5 days representing 23% of sessions. The usual observers and another trained experimenter recorded naturally occurring behaviors and reinforcers as specified earlier. Interobserver agreement was computed as the number of agreements divided by the number of agreements plus disagreements multiplied by 100. The interobserver agreement score reached 86%.

### Results

Figure 1 shows the frequencies of playing and other behaviors and Figure 2 shows their corresponding frequencies of social attention from peers and educators. In general, playing behaviors were more frequent than other behaviors. Eloi, John, and Math's respective playing behaviors represented 68%, 68%, and 81% of a 9-min-session on average, respectively. On average, 36%, 42%, and 55% of children's playing behavior were reinforced by social attention, whereas other behaviors were reinforced by 18%, 22%, and 21% of their occurrence.

Least squares regressions were carried out to analyze matching relations by correlating log response rate ratio to log reinforcer rate ratio (for more details see Reed, 2009). Analyses indicated that the rate of playing compared to other behaviors matched the rate of contingent attention from peers and educators. Figure 3 presents the matching relation of each participant. The GML accounts for 94%, 73%, and 90% of the variance of

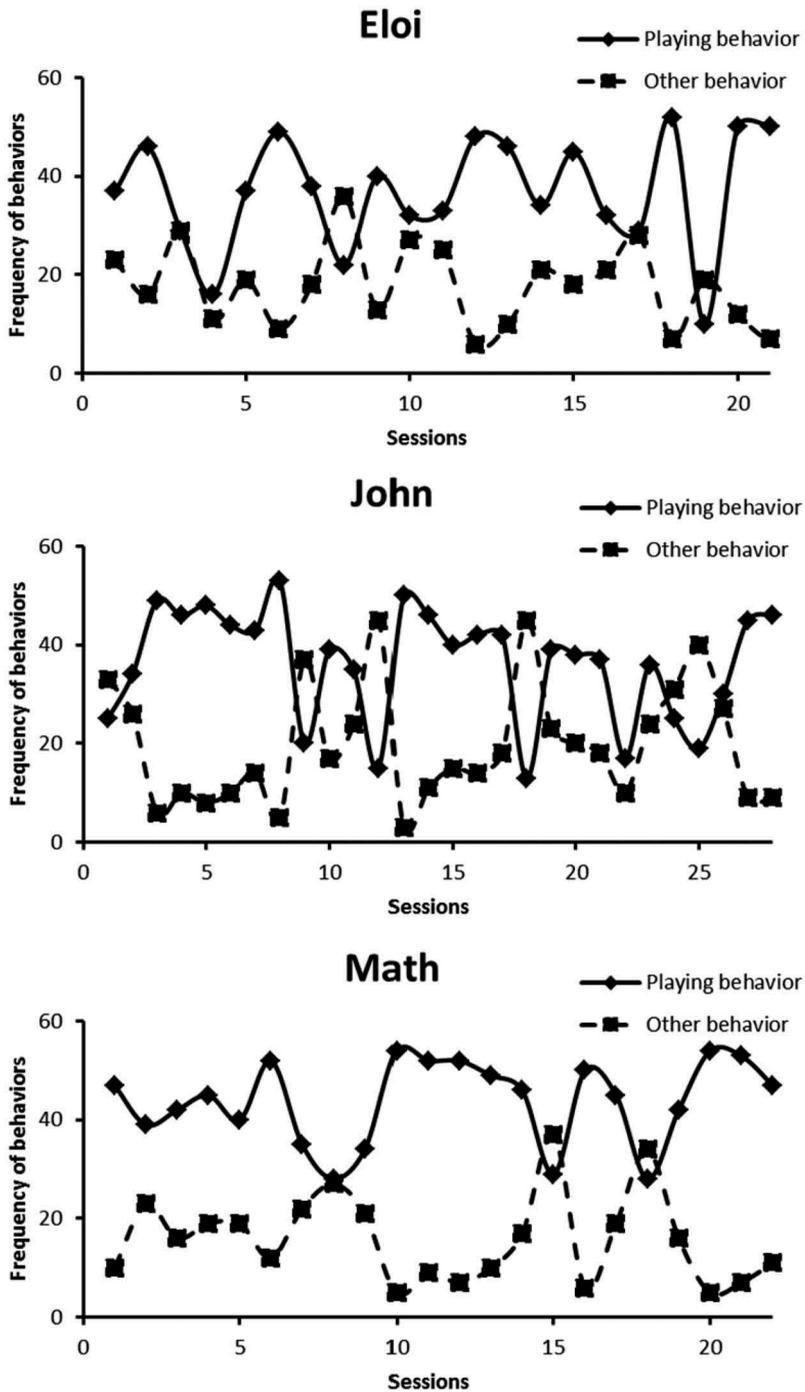


Figure 1. Frequency of playing and other behaviors across sessions.

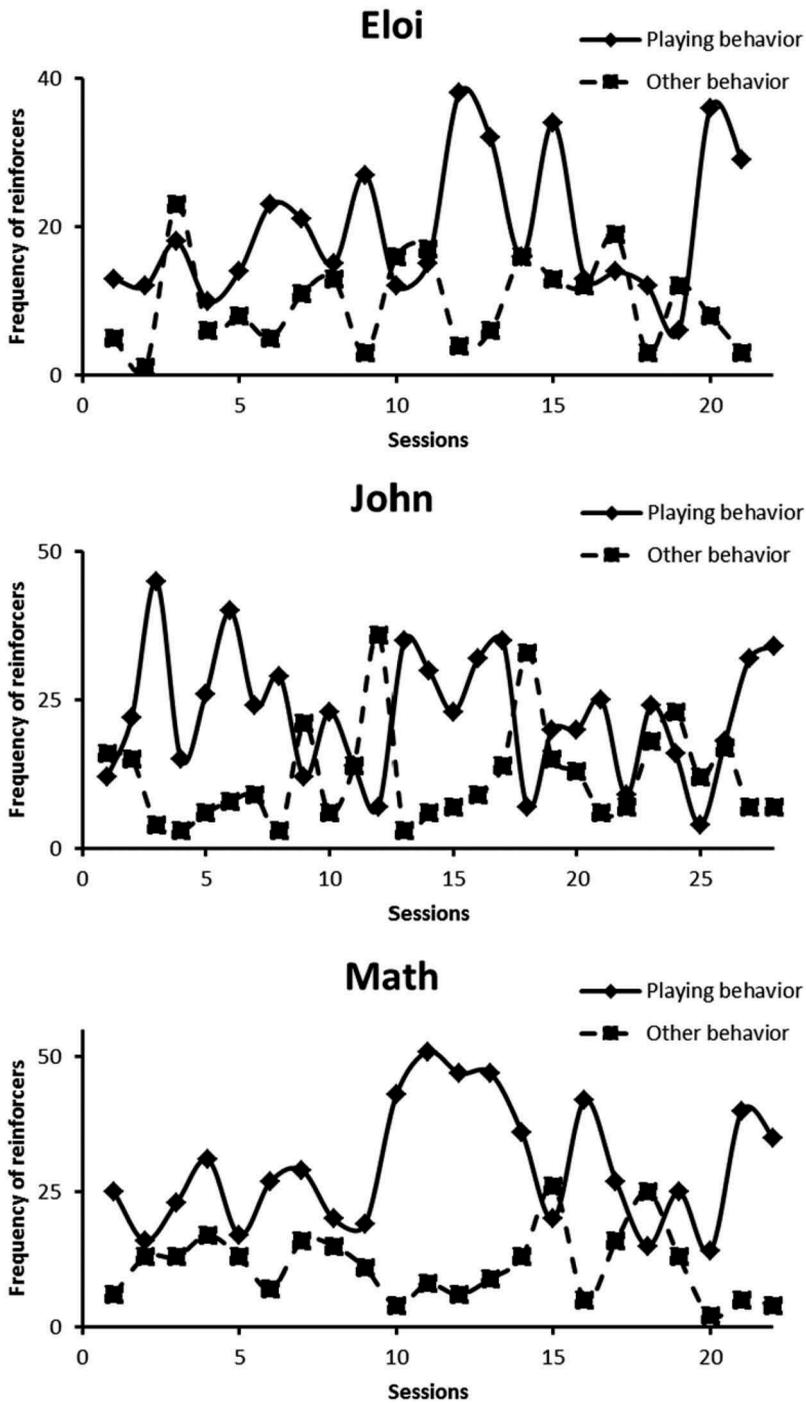
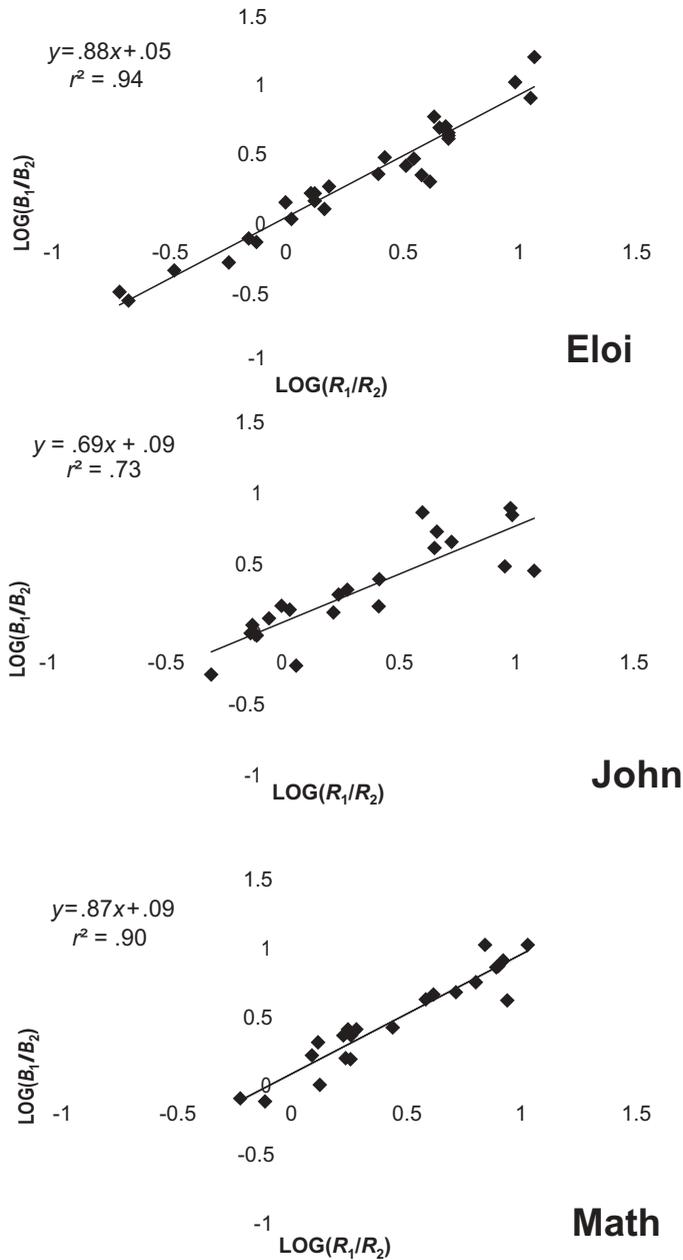


Figure 2. Frequency of reinforcers associated to playing and other behaviors across sessions.



**Figure 3.** Each panel depicts the matching relation of a participant. Data were analyzed according to the generalized matching equation. Values for the sensitivity, the bias, and the explained variance are shown in the upper-left corner of each panel. Results show slight undermatching for Eloi and Math and important undermatching for John.  $\text{Log}(c)$  is nearly equal to zero for the three participants. Finally, explained variances ( $r^2$ ) are quite similar to other published results.

the relation between behavior and reinforcer rate ratios. The sensitivity values (slopes) were .88, .67, and .87 suggesting that responses were emitted as a function of changes in social reinforcer ratios. Slight undermatching (sensitivity lower than 1, see Baum, 1974) was observed for Eloi and Math and steeper undermatching was found for John.

These results are also quite similar to other published data which found that undermatching was the norm among animals and humans (Davison & McCarthy, 1988). Bias values (intercept) were positive and below .10 indicating a slight preference for playing behavior rather than other behavior.

## Discussion

The purpose of the current study was to examine the relation between play behaviors of three children with typical development and naturally occurring social reinforcer ratios provided by their educator and peers. The current results show that the GML can describe play behavior of typical preschool children. As shown in Figure 3, the GML explained the majority of the variance. These results are more consistent (in terms of explained variance) than other descriptive analyses with participant having developmental disabilities (Borrero et al., 2010; Rivard et al., 2014; St. Peter et al., 2005). Social sensitivity of children to staff and peers' attention can be partly attributable to whether they have disabilities or not (Rivard et al., 2014). The matching relations were quite similar to other published results in which subjects (humans and animals) showed undermatching and slight preferences for a given behavior (Davison & McCarthy, 1988). As Rivard et al. (2014) suggested, the GML seems to be an adequate model to assess the operant function of social attention.

One interesting aspect of the current study is the naturally occurring rate of social attention. Since no controlled or predictable reinforcer ratios were used (no significant autocorrelations were found,  $p = .53$ ,  $p = .30$ , and  $p = .24$ , for each child), results suggest that children's behavior adjusted to unpredictable reinforcer ratios. In other terms, behaviors did not need to reach a steady state to follow conform to the GML. The situation is quite similar to the Davison and Baum's (2000) experiment in which reinforcer ratios were manipulated in a random fashion throughout the experiment. Like the Davison and Baum's participants, children's playing behavior were effectively sensitive to the contingencies of reinforcement (sensitivity and bias values were similar and variance accounted for were high). The comparable results suggest that the contingencies of the current study might be analogically similar to the Davison and Baum's experiment. Thus, it may be argued that the assumption of the steady state operant can be loosened in natural settings. It suggests that there may be no need in natural settings to wait for the operant to reach a steady state as long as participants have been consistently behaving in the contingencies of reinforcement. This contribution is important for clinical studies involving the GML in which it might be impracticable to manipulate the reinforcer ratios and where waiting for the operant to reach a steady state is either unethically or nearly experimentally impossible.

Finally, the current results must be interpreted with some caution because of the small sample size (three children) and the correlational nature of matching analyses. No experimentally controlled independent variable was involved and no experimental functional analysis was performed to identify the operant function of the behavior of

each child. St. Peter et al. (2005) suggested that, without careful examination of the operant function of social attention, matching analyses could lead to spurious results. Whether results were due to spurious matching or a naturally occurring phenomenon will need further investigations. Nevertheless, the amount of data collected (at least 19 sessions which is more than other comparable studies) and the functional analysis interview ensured some confidence in the operant function of the play behaviors and in the results from GML. In sum, the GML can successfully describe play behaviors of typical preschool children in a descriptive analysis.

## Ethical approval

This study obtained ethical approval from the Comité d'éthique de la recherche pour les projets étudiants impliquant des êtres humains (Ethical committee for student research projects on human beings) of the Université du Québec à Montréal.

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## Disclosure statement

No potential conflict of interest was reported by the authors.

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## References

- Baum, W. M. (1974). On two types of deviation from the matching law: Bias and undermatching. *Journal of the Experimental Analysis of Behavior*, 22, 231–242. doi:10.1901/jeab.1974.22-231
- Borrero, C. S. W., Vollmer, T. R., Borrero, J. C., Bourret, J. C., Sloman, K. N., Samaha, A. L., & Dallery, J. (2010). Concurrent reinforcement schedules for problem behavior and appropriate behavior: Experimental applications of the matching law. *Journal of the Experimental Analysis of Behavior*, 93, 455–469. doi:10.1901/jeab.2010.93-455
- Davison, M., & Baum, W. M. (2000). Choice in a variable environment: Every reinforcer counts. *Journal of the Experimental Analysis of Behavior*, 74, 1–24. doi:10.1901/jeab.2000.74-1
- Davison, M., & McCarthy, D. (1988). *The matching law: A research review*. Hilldale (NJ): Erlbaum.

- Forget, J. (1981). Programme de recherche sur l'implantation d'un modèle d'enseignement systématique: Aspects méthodologiques et résultats [Research program on the establishment of a systematic teaching model: Methodological aspects and results]. *La Technologie Du Comportement*, 5, 99–112.
- Mace, F. C., & Critchfield, T. S. (2010). Translational research in behavior analysis: Historical traditions and imperative for the future. *Journal of the Experimental Analysis of Behavior*, 93, 293–312. doi:10.1901/jeab.2010.93-293
- McDowell, J. J. (1981). On the validity and utility of Herrnstein's hyperbola in applied behavior analysis. In C. M. Bradshaw, E. Szabadi, & C. F. Lowe (Eds.), *Quantification of steady-state operant behaviour* (pp. 95–109). North Holland: Elsevier.
- McDowell, J. J. (2013). On the theoretical and empirical status of the matching law and matching theory. *Psychological Bulletin*, 139, 1000–1028. doi:10.1037/a0029924
- O'Neill, R. E., Horner, R. H., Albin, R. W., & Sprague, J. R. (1997). *Functional assessment and program development for problem behavior: A practical handbook*. Pacific Grove: Brooks/Cole Publishing.
- Reed, D. D. (2009). Using Microsoft Office Excel® 2007 to conduct generalized matching analyses. *Journal of Applied Behavior Analysis*, 42, 867–875. doi:10.1901/jaba.2009.42-867
- Rivard, M., Forget, J., Kerr, K., & Bégin, J. (2014). Matching law and sensitivity to therapist's attention in children with autism spectrum disorders. *The Psychological Record*, 65, 79–88. doi:10.1007/s40732-014-0015-1
- Sattler, J. M. (2002). *Assessment of children: Behavioral and clinical applications*. San Diego (CA): Sattler.
- St. Peter, C. C., Vollmer, T. R., Bourret, J. C., Borrero, C. S. W., Sloman, K. N., & Rapp, J. T. (2005). On the role of attention in naturally occurring matching relations. *Journal of Applied Behavior Analysis*, 38, 429–443. doi:10.1901/jaba.2005.172-04