**Kinetic Classifications for Assessment of Typical and Atypical Infant Play Behavior with Toys**

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**Introduction**

**Preterm Birth:**
- Affects 1 in 10 infants. Rates are rising.
- Is the leading cause of death for children under five years of age worldwide.
- Can lead to lifelong neurodevelopmental concerns.

**The Clinical Perspective:**
- Movement capabilities develop along a set of expected milestones in infancy; infants not adhering to these milestones are developing “atypically” and potentially considered at-risk.
- Standard guidelines (Peetfeldt and BINS) for measuring movement development rely heavily on the eye of a trained professional, and thus can be inaccessible.
- Infant brain plasticity is high; early intervention into potential delay is crucial for optimal recovery.

**Our Approach:**
- Using our Play and Neuro Development Assessment (PANDA) Gym, we developed a set of activity classifications to serve as a metric in quantifying movement patterns across infant populations.

**Objective:**
- Typically developing infants were expected to engage with the gym and toys more voluntarily, and with greater overlapping of individual interactions, than their atypical counterparts.
- Using video data gathered from the PANDA Gym, is it possible to quantify movement with activity classification patterns from infants as a potential metric in distinguishing atypical from typical behavior?

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**Activity Classifications**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Involuntary†</td>
<td>Unintentional, does not appear to be the intended target of contact, interaction usually without visual engagement.</td>
</tr>
<tr>
<td>Gaze†</td>
<td>Direct eye contact/attention directed at toy; determined by pupil direction and/or head angle.</td>
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<tr>
<td>Mouth Touch†</td>
<td>Toy touches lips or enters mouth of infant.</td>
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<tr>
<td>Hand Touch †</td>
<td>Physical contact with toy but fingers and/or palm do not close around toy.</td>
</tr>
<tr>
<td>Hand Grasp †</td>
<td>Physical contact with toy but fingers and/or palm do close around toy.</td>
</tr>
<tr>
<td>Foot Touch †</td>
<td>Contact of foot with toy. Usually more prolonged than a kick.</td>
</tr>
<tr>
<td>Foot Kick †</td>
<td>Contact of foot with toy involving greater force than a touch. Usually shorter term than a touch.</td>
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</tbody>
</table>

**Table 1.** Collection of activity classifications used to evaluate each infant's voluntary interaction; involuntary interaction.

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**Results & Discussion**

**Table 2.** (left) Overall interaction time totals and metrics.

**Table 2.** (above) represents total interaction times for both the elephant and lion toy combined, for each the typical and atypical infant groups.

**Typical**

<table>
<thead>
<tr>
<th>Infant Group</th>
<th>Voluntary Interactions (s)</th>
<th>Involuntary Interactions (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical (n=7)</td>
<td>2,823.20</td>
<td>650.30</td>
</tr>
<tr>
<td>Atypical (n=8)</td>
<td>3,737.00</td>
<td>511.40</td>
</tr>
</tbody>
</table>

**Mean Total Interaction Time (s)**

The data in Table 2 (above) represent total interaction times for both the elephant and lion toy combined, for each the typical and atypical infant groups. This data is further classified by toy in the charts below.

**Upper Body:**
- Typically developing infants engaged more voluntarily than the elephant but less involuntarily than the atypical infants

**Lower Body:**
- Typically developing infants engaged more voluntarily and more involuntarily than atypical infants

**Notes:**
- Typically developing infants had 6.1 more voluntary interactions than their atypical counterparts with the elephant toy
- The lion toy engaged less interaction overall, possibly due to the general nature of infant movement development at this age
- The greatest amount of simultaneous/overlapping interactions occurred in the typically developing infants

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**Conclusion**

Typically developing infants, on average, engage with their surroundings (gym and toys) more than their atypical counterparts, and with greater overlapping of individual interactions. This is especially true for voluntary interactions, and for upper body engagement. Although atypical infants were shown to outperform typical infants marginally in some trials, they overall don’t engage as frequently with their surroundings/the toys as typical infants. Any outlier scenarios were clear and didn’t drastically affect the overall coded interaction data, but further analysis of all infants in initial pilot is necessary to confirm.

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**Graphs and Images**

**Figure 1.** (above) A. Full setup of the PANDA Gym. B. Elephant toy on left and Lion toy on right; used for upper and lower body play engagement, respectively.

**Figure 2.** (below) A. Infant visually engaged with the lion toy. B. Infant not visually engaged with lion toy but foot made contact with toy in an involuntary manner. C. Infant visually engaged with toy by grasping trunk while touching face (simultaneously). D. Infant visually engaged with toy while touching with foot (simultaneously).

**Figure 3.** (left) Total interaction times for preterm and full-term infants with A, the elephant toy; and B, the lion toy.