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## **Fidelity of Implementation of Activity-Based Intervention (ABI) in Daycare**

Despite the recognized effectiveness of naturalistic intervention practices, including activity-based intervention (ABI), challenges remain regarding their implementation. Assessing implementation fidelity can help understand factors that may influence their implementation. This study aims to document the evolution of ABI implementation fidelity (Adherence, Dosage, Quality and Participant responsiveness) in daycare settings following professional development. The participants are four educators. The current study uses an embedded design. The predominant aspect is quantitative, that is, single-case research design with three measurement phases of 12 observation moments. In terms of Dosage, an increase in frequency of learning opportunities offered by educators is observed as the experiment progresses. For three educators, results show moderate and significant effects of professional development between Phases 1 and 3: 1) Nonoverlap of all pairs (NAP) = 0.84 ( $p < 0.01$ ); 2) NAP = 0.78 ( $p < 0.05$ ); 3) NAP = 0.87 ( $p < 0.01$ ). A slight decrease in Quality can be observed when learning opportunities are adapted to children's developmental levels. This article highlights the importance of documenting several components of implementation fidelity.

Keywords: naturalistic intervention, implementation fidelity, daycare

### **Introduction**

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Activity-based intervention (ABI) is a naturalistic intervention approach that aims to support the development of essential skills in children at risk of developmental difficulties, with or without disabilities (Johnson et al., 2015). Naturalistic intervention approaches are characterized by the use of games and daily life routines to promote child development (Horn & Banerjee, 2009). ABI is recognized as a well-detailed and structured naturalistic approach (Bakkaloglu, 2008). The starting point for ABI is the assessment of child development based on observations of the child in interaction with his or her physical and human environments (Johnson et al., 2015). The main dimension of naturalistic practices and ABI is integration of intentional and systematic interventions in everyday life, for example, snacking or a handwork activity (Özen & Ergenekon, 2011; Snyder, Rakap, et al., 2015). Intentional interventions translate into learning opportunities for children, ones that are adjusted to the children's developmental levels. These learning opportunities are embedded in three contexts: 1) free play; 2) routines; and 3) structured play activities (Johnson et al., 2015). Within these three contexts, the adult must follow the children's initiatives by building on their interests so they can acquire and generalize skills. Adults must also offer many and diverse learning opportunities. Reinforcers are intended to be as logical and natural as possible. For example, if a child learns to zip his or her coat and reproduces the behaviour, a logical reinforcement would be to go outside and play. Adapting an environment to promote the emergence of certain skills is an intervention itself.

In studies focusing on ABI as support of early childhood development, developmental improvements are observed in different areas: language (King et al., 2013; Rahn et al., 2016; Sajaniemi, 2010); preschool skills (Bakkaloglu, 2008); motor skills

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(Apache & Goyakla, 2005); and emergent literacy (Grisham-Brown et al., 2006; Kimhi et al., 2017). Although the effectiveness of ABI has been recognized, challenges remain regarding its implementation as intended (with fidelity) in natural settings (Snyder, Rakap, et al., 2015). The aim of the present study is to document the evolution of fidelity in implementing ABI in inclusive daycare settings.

### ***Naturalistic intervention practices in daycare***

In Québec, Canada, daycare services are under the responsibility of the Ministry of the Family (MFA) and are separate from kindergarten, which falls under the Ministry of Education. This public network is governed by the *Educational Childcare Act*, and the services provided are integrated into an educational program. In 2016, over 50% of Québec children aged 0 to 6 attended provincial daycare centres (MFA, 2019b). Most daycare educators have college diplomas (associate's degree in the United States) in early childhood education. The 3-year program focuses on knowledge of children's needs and support through education. The daycare centres use the *Accueillir la petite enfance* educational program (MFA, 2019a) and promote naturalistic intervention practices. Indeed, intervention practices in Québec daycares are based on the premise that children acquire new skills through exchanges with their physical and human environments (MFA, 2019a), a key principle of ABI practices (Bricker & Pretti-Frontczak, 2004; Johnson et al., 2015). Play, child-initiated activities and consideration of children's interests are regarded as main aspects of learning (Ministère de la Famille et des Aînés, 2014; MFA, 2019a). In concrete terms, the MFA (2019a) points out that periods of free play, activities structured by adults and daily routines are used to stimulate all aspects of children's development.

However, there seem to be differences between the theoretical ideal of these practices and their implementation by educators, as evidenced by results of surveys on quality of educational services in daycare settings (Drouin et al., 2003; Gingras et al., 2015; Lavoie et al., 2015). Those surveys focused on implementation of the educational program in terms of 1) how to structure the physical environment; 2) organization and diversification of activity types; and 3) exchanges between educators and children. Results highlight that playtime in general is not sufficiently valued. Access to free-play workshops that allow children to be the master builders of these learning activities is insufficient. The results also identify a lack of setting and materials organization by daycare educational staff to support play. Work remains to be done to ensure that the principles that should guide educators' interventions in daycare settings are implemented accurately and as planned.

For Odom (2009), the implementation process could explain the difficulties in implementing with fidelity intervention practices to support early childhood development. Regarding naturalist intervention practices, Snyder et al. (2018) and Stahmer et al. (2015) specifically target a need for comprehensive training and personalized professional support to achieve high implementation fidelity. From this perspective, the following section emphasizes different elements highlighted in the scientific literature to support effective implementation of a program or intervention practices (PIP).

### ***Elements to consider for a successful implementation***

A first element for successful implementation is the availability of reference literature that details the PIP (Dane & Schneider, 1998; Metz et al., 2013). The PIP must be

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adapted to the needs and characteristics of both setting and participants (Dane & Schneider, 1998; Huang et al., 2014; Sutherland et al., 2013). A number of authors (Domitrovich et al., 2010; Fox et al., 2011; Trivette & Dunst, 2013) agree that acquiring new intervention practices requires professional development, and that professional development must use training and coaching practices recognized as effective. Professional development helps achieve implementation fidelity of naturalistic intervention practices that could have developmental effects on young children (Dunst et al., 2013). Therefore, it is important to focus on the implementation fidelity of naturalistic intervention practices in daycare settings. But first we must look at what fidelity of implementation is.

### ***Implementation fidelity of PIP***

Implementation fidelity is defined as the use of PIP in the field as intended by the developers. Generally, according to Dusenbury et al. (2003), implementation fidelity is conceptualized into the five components formulated by Dane and Schneider (1998): *Adherence, Dosage, Quality, Participant responsiveness* and *Differentiation*. *Adherence* is the implementation of all the important dimensions of the PIP. *Dosage* is the quantity or duration of the intervention. *Quality* refers to the way in which the PIP is used according to a theoretical and relational ideal. *Participant responsiveness* is defined as the participation of people receiving the intervention. *Differentiation* is a method to distinguish between types of interventions, for example, those used in the experimental conditions of a study and those in the control conditions. In the field of preschool intervention, very few studies evaluate implementation fidelity using all these components (Domitrovich et al., 2010). The one that is the least used to assess fidelity in

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studies is *Differentiation* (Caron et al., 2017; Dane & Schneider, 1998). For Century et al. (2010), *Differentiation* does not provide information on implementation of intervention practices as planned.

Some studies aim to establish a more complete portrait of fidelity intervention practices to support early childhood development. For instance, using structural equation model, Guo et al. (2016) examined the direct and indirect effects of fidelity (*Adherence, Dosage, Participant responsiveness, Program differentiation*) on development of emerging literacy skills. Their results highlight the importance of assessing many dimensions of fidelity to improve practice use. Hamre et al. (2010) looked at the link between implementation fidelity (*Dosage, Adherence and Quality*) of *My Teaching Partner literacy and language activities* and improvements in literacy and language in children. Their results showed that the *Quality* component has a higher association with developmental improvements than the *Dosage* component. Adherence is not associated with any improvement in children.

Assessing fidelity verifies if interventions are implemented as intended and can help to explain factors that may influence the relative success of implementation (Dusenbury et al., 2003). In Québec's daycare settings, there appear to be difficulties regarding implementation fidelity of recommended intervention practices. The purpose of this study is to assess fidelity of implementation of ABI in daycare settings to support the development of emergent literacy skills. The research question is as follows: How does fidelity of implementation of ABI evolve with respect to the four components—*Adherence, Dosage, Quality and Participant responsiveness*—following professional development, that is, group training and individualized professional coaching?

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### ***Context of the study***

A daycare setting in the province of Québec (Canada) is implementing ABI practices to support literacy skills development. The choice to focus on emergent literacy responds to a need identified by the daycare. In 2018, an evaluation of educational practices used by daycare staff was conducted (Association québécoise des CPE, 2019). It highlights a need to improve practices to promote emergent reading and writing skills. Also, considering the positive links between emergent literacy skills and academic success (Duncan et al., 2007; National Early Literacy Panel, 2008), it is important to develop these skills in young children (Christie & Roskos, 2013; Myre-Bisaillon et al., 2010).

### **Method**

#### ***Study design***

This study uses an embedded design (Creswell & Plano Clark, 2011). Quantitative and qualitative data are collected simultaneously. The predominant aspect is quantitative, that is, a single-case multiple treatment design (ABC) with three phases of 12 observation moments used to document *Dosage* evolution. Qualitative data complement quantitative data. Also, quantitative and qualitative data are combined to discuss the results (Creswell, 2009).

#### ***Participants***

The participants are four female educators from the same daycare setting. Their average age is 33.5 years ( $SD= 6.44$ ). They all have college degrees in early childhood education. One participant has a bachelor's degree in psychology. One educator has 0 to 5 years of experience; two educators have 5 to 10 years of experience, and one has over 20 years.

Each educator is responsible for a group. In each group, one or more children are considered at risk or have disabilities. These children have been suspected to have or diagnosed with sensory, language or behavioural difficulties, or autism. In total 37 children are involved in this research. Table 1 shows the composition of each group.

**Table 1**

*Composition des groupes d'enfants*

	Sexe		Age (months)		<i>Typical</i>	Development	
	Girls	Boys	M	SD		<i>At risk</i>	<i>With disabilities</i>
Groupe A ( <i>n</i> = 9)	2	7	22.89	2.52	6	3 (2L, B)	0
Groupe B ( <i>n</i> =10)	2	8	32.4	4.67	6	3 (L, B, ASDS)	1 (SPDD)
Groupe C ( <i>n</i> = 9)	6	3	54.33	5.00	8	0	1 (ASDD)
Groupe D ( <i>n</i> = 9)	4	5	58	3.71	7	2 (L, B)	0

*Note.* L : language difficulties; B : behavioural difficulties; ASDS/ASDD : autism spectrum disorder suspected/diagnosed; SPDD : sensory processing disorders diagnosed

***Process***

The study began in January 2019 and was completed at the end of April 2019. Table 2 shows progress over time of the various research activities: professional development and time when the data collection tools or methods were used.



**Table 2**

*Sequence of the Experiment Over Time*

	January	February	March	April	May
<b>Prof. dev.</b>		Training		Coaching	
<b>Data collection</b>	Literacy Area Video P1 <i>What I'm doing</i>		Video P2		Video P3 <i>Observation grid</i> <i>What I'm Doing</i> <i>ABI Quality Checklist</i>
		<i>Educators' logbook</i>			

*Note.* Prof. dev. = professional development; P1 = phase 1.

The professional development practices in this study are based on the *Participatory Adult Learning Strategy* (PALS; Dunst and Trivette, 2009) and *Practice-Based coaching* (PBC) framework (Snyder, Hemmeter et al., 2015). The principal researcher conducted a one-and-a-half day training session that covered the main components of ABI and early literacy skills. She has several years of experience in professional development. She attended two days of training with the creators of the PBC, and then carried out the coaching process on a one-to-one basis, in three iterative steps: 1) shared goals and development of an action plan; 2) targeted observation based on the action plan; and 3) feedback and reflection. Two one-hour meetings were held with each educator in addition to the targeted observation time.

***Data collection***

Various tools and methods are used to collect data on implementation fidelity in accordance with the variables under study, that is, the four components: *Adherence*, *Dosage*, *Quality* and *Participant responsiveness*. Table 3 presents and combines the

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indicators, various data collection tools and analyses carried out for each component.

Then, the elements of data collection are presented according to the study chronology.

**Table 3**

Fidelity components	Indicators	Data collection tools	Analyses
<i>Adherence</i>	<ul style="list-style-type: none"> <li>- Assessing developmental level</li> <li>- Learning opportunities offered in the three activity contexts</li> <li>- Environmental adaptations</li> </ul>	<ul style="list-style-type: none"> <li>- Observation grid for learning opportunities</li> <li>- <i>What I'm Doing</i> questionnaire</li> <li>- Logbook</li> </ul>	<ul style="list-style-type: none"> <li>- Descriptive</li> <li>- Qualitative</li> </ul>
<i>Dosage</i>	<ul style="list-style-type: none"> <li>- Frequency of learning opportunities for children</li> </ul>	<ul style="list-style-type: none"> <li>- Observation grid for learning opportunities</li> <li>- Logbook</li> </ul>	<ul style="list-style-type: none"> <li>- Descriptive</li> <li>- Visuals</li> <li>- Nonoverlap, effect sizes</li> </ul>
<i>Quality</i>	<ul style="list-style-type: none"> <li>- Adjusting learning opportunities to child development</li> <li>- Antecedents, reinforcements/ consequences: natural and logical; integrated into current activity and carried out at appropriate time</li> </ul>	<ul style="list-style-type: none"> <li>- <i>ABI Quality checklist</i></li> <li>- <i>What I'm Doing</i> questionnaire</li> </ul>	<ul style="list-style-type: none"> <li>- Descriptive</li> <li>- Qualitative</li> </ul>
<i>Participant responsiveness</i>	<ul style="list-style-type: none"> <li>- Child participation in the learning opportunity</li> </ul>	<ul style="list-style-type: none"> <li>- Observation grid for learning opportunities</li> </ul>	<ul style="list-style-type: none"> <li>- Descriptive</li> </ul>

*Literacy Area, 0 to 6 years old (Early Intervention Management and Research Group [EMRG], 2018)*

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Before the training session, the educators complete the assessment grid *Literacy Area, 0 to 6 years old* (EMRG, 2018) to assess children's developmental literacy levels. This evaluation grid has excellent interrater agreement,  $kr = 0.82$  (Lemire et al., 2015).

#### *What I'm Doing questionnaire*

Educators complete the questionnaire developed for this study twice: once before starting the experiment and a second time at the end of the project. The questionnaire documents literacy learning opportunities available in different contexts, including environmental adaptations; how educators situate children's developmental literacy levels; and how educators ensure that learning opportunities are adjusted to development.

#### *Video observation*

The principal researcher records the videos in three phases: Phase 1 (baseline), Phase 2 (after training), and Phase 3 (after coaching). For each phase and each educator, three contexts of activity are filmed 4 times: 1) free play, 2) snacking, and 3) structured play. Videos last a minimum of 10 minutes. The choice of four videos per type of activity allows for 12 observation moments and meets the quality standards of single-case research in terms of number of data collection moments per phase. The minimum threshold of moments per phase is three (Kratochwill et al., 2013; Lanovaz, 2013).

#### *Logbook*

The logbook is completed every week starting from Phase 2, that is, following training. It is divided into two sections. The first section consists of open-ended questions concerning challenges and facilitators to integrating learning opportunities; the second is a five-point Likert scale used to document educators' perceptions of their integration of

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learning opportunities as planned during the week: 'much more often', 'more often', 'exactly', 'less often' or 'not at all'.

#### *Observation grid for learning opportunities*

The observation grid is completed with the help of videos. The video rating method uses partial-interval observation as a model (Magerotte & Willaye, 2010). In this study, total observation time is divided into equal intervals of 15 seconds. The first 15-second period is used for observation, and recorded in the grid. The next 15-second period is not rated, and so on, alternating for 10 minutes of video time. The following information is collected in the observation grid for each learning opportunity offered: antecedents (verbatim, behaviour or environmental adaptation), child's response or lack of response, absence or presence of reinforcement/consequence. A research assistant and the principal researcher observe and rate 30% ( $n = 43$ ) of the videos. Interrater agreements are calculated for this 30%. The average agreement rate is 87.6%, which meets the standards described by Kratochwill et al. (2013).

#### *ABI quality checklist*

For 30% of the videos, the following elements are collected: logical/natural antecedent or not, logical/natural reinforcement/consequence or not; opportunity offered adapted to the developmental level of the group or not. This information is used to complete ABI Quality checklist, which consists of a five-point Likert scale: 'always', 'often', 'sometimes', 'rarely', 'never'. It documents the *Quality* component: concordance between children's level of development and opportunities offered, and quality of antecedents and reinforcements/consequences. It is completed for each of the three phases and for each educator by consensus of the two observers.

## **Analyses**

### ***Descriptive analyses***

Descriptive analyses (frequency and percentage) are carried out for frequency and quality of learning opportunities offered, and children's participation in the learning opportunities.

### ***Visual analyses***

In this study, frequency of learning opportunities is represented graphically, as proposed by Magerotte and Willaye (2010). Visual analyses of intra- and interphase data are performed according to the following four characteristics: level, trend, variability and immediacy of the effect (Ledford et al., 2017).

### ***Analysis of non-overlapping and effect sizes***

In addition to the visual analysis, a *Nonoverlap of All Pairs* (NAP; Parker & Vannest, 2009) analysis is performed. NAP is the percentage of data for which there is improvement from one phase to the next. Effect sizes are assessed based on Parker and Vannest's (2009) proposal that 0.93 to 1.00 indicates a significant effect; 0.66 to 0.92 an average effect and 0 to 0.65 a low effect.

### ***Qualitative analyses***

Data from the open-ended questions are analysed by the principal investigator in steps, as defined by Miles et al. (2014). A master's student transcribes handwritten data using MS Word. Data are then condensed using a matrix. The matrix categories are the indicators from the *Adherence* and *Quality* components. In this step, all transcripts are carefully read several times. The data (text extracts) are classified in the matrix. Then, the

following strategies are used to interpret the data and draw conclusions: identify themes, group and count.

## **Results**

The main objective of this study is to document the evolution of implementation fidelity of ABI practices after professional development. The results are presented by fidelity components: *Adherence, Dosage, Quality* and *Participant responsiveness*.

### ***Adherence***

*Adherence* refers to 1) assessment of children's developmental level; 2) embedding of learning opportunities in the three activity contexts: snacking, free play and structured play; and 3) presence of environmental adaptations.

#### *Assessment of children's developmental level*

According to the responses to the *What I'm doing* questionnaire analysed in Phase 1, two educators mention that level of development was based on the children's interests. 'I'm seeing more and more interest in books and stories.' Another educator reports that she cannot assess her group's level of literacy development, but she describes what the children are able to do. '...able to recognize letters, some of the numbers and their first names.' In Phase 3, one educator reports referring to *Literacy Area, 0 to 6 years old* (EMRG, 2018) to determine the children's developmental levels. Another educator says she observes the children to determine what they are capable of doing. 'Watching them, I notice that they are now able to turn one page at a time.' The other educators responded using the children's interests as a basis for determining the level of development.

#### *Learning opportunities in the three activity contexts*

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In Phase 1, three of the four educators embed learning opportunities into the three activity contexts. Only one educator offers learning opportunities in two out of three contexts: free play and structured play. In Phases 2 and 3, opportunities are observable in all three contexts of activity for all educators.

#### *Adaptation of the environment*

Results show that environmental adaptations improve as the experiment progresses. Between Phase 1 and Phase 3, the number of examples of environmental adaptation reported by educators more than doubled. New adaptations include objects (toothbrushes, lockers) identified with children's names, everyday objects (paint cans, storage bins) identified by a written word or pictogram, and the addition of literacy materials in the room (restaurant menus, magnetic letters).

#### *Dosage*

*Dosage*, which refers to the frequency of learning opportunities offered to children, is documented with the observation grid and the logbook. Figure 1 shows the evolution of dosage over the three phases for the four educators. Results from the logbooks are presented following those from the observations.

#### *Educator A, observational data*

For Educator A, results show that in Phase 1, there is an average of 6.33 ( $SD= 6.50$ ) learning opportunities. Two observation points (no. 2 and no. 3) have high frequencies, hence the large standard deviation. For the other data, low dispersion with slight deceleration is observed. In Phase 2, where the average is 13.33 ( $SD= 10.1$ ) learning opportunities, there is gradual acceleration. A gradual deceleration is noted in Phase 3, with an average of 9.25 ( $SD = 8.80$ ) learning opportunities. Between Phase 1 and Phase

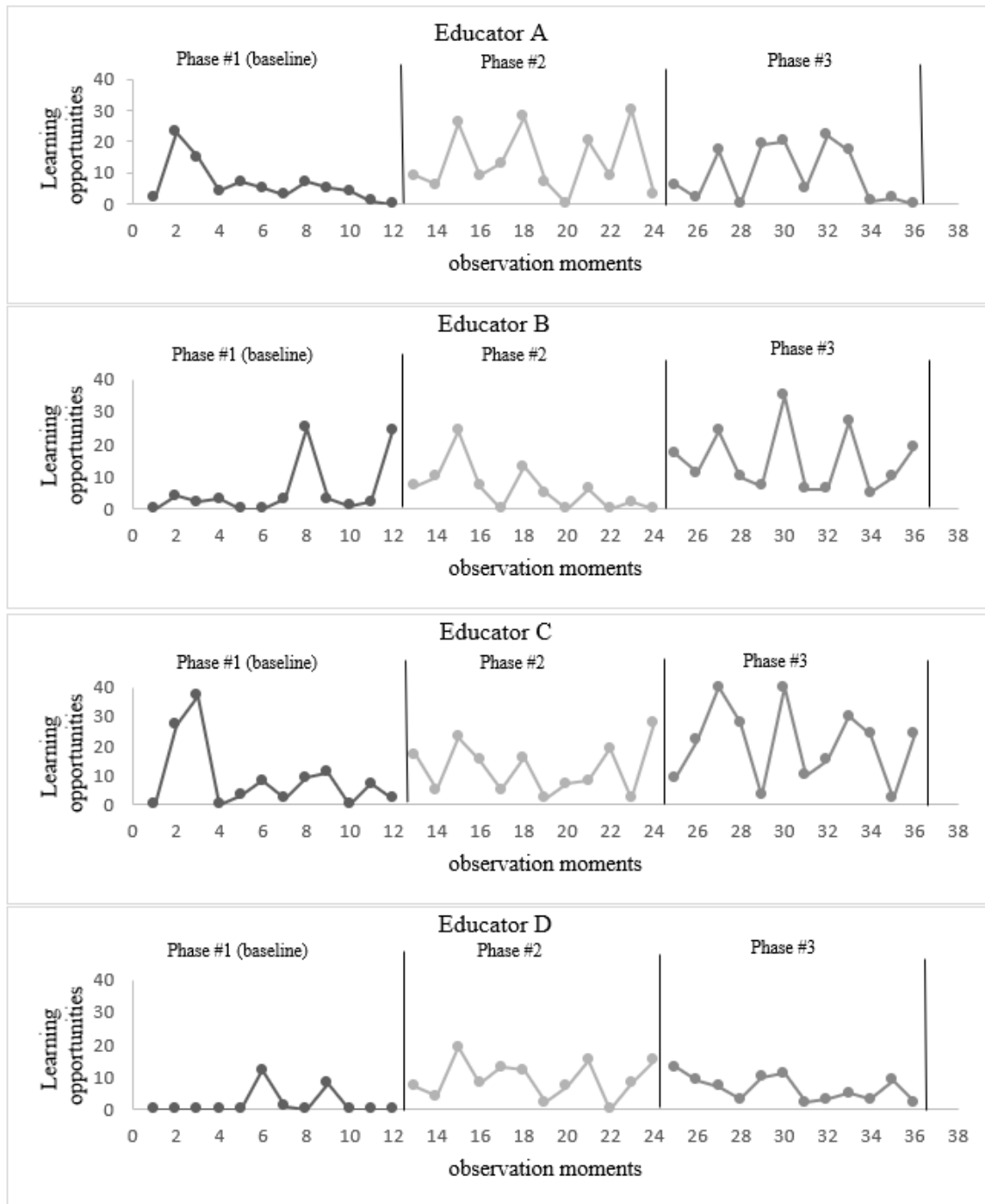


Figure 1. Frequencies of learning opportunities. Observation moments according to activity contexts are in the following order: no. 1 snacking; no. 2 free play; no. 3 structured play; no.4 snacking; no. 5 free play; no. 6 structured play; etc. Training was provided between Phases 1 and 2; coaching was provided between Phases 2 and 3.



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2 an immediate effect of the training is observed. Results tend to show no immediate effect between Phases 2 and 3, with the latter corresponding to coaching.

For non-overlapping analyses (NAP), between Phases 1 and 2, results indicate a significant and moderate effect, with  $NAP = 0.75$  ( $p < 0.05$ ), 95% CI (0.54, 0.96). Results indicate no significant effect between Phases 1 and 3 [ $NAP = 0.54$  ( $p = 0.75$ ), 95% (0.29, 0.78)] and between Phases 2 and 3 [ $NAP = 0.35$  ( $p = 0.20$ ), 95% (0.12, 0.57)]. In summary, results show a positive evolution of *Dosage* between Phases 1 and 2.

#### *Educator B, observational data*

Analyses indicate respective averages for Phases 1, 2 and 3 of 5.58 ( $SD = 8.90$ ), 6.17 ( $SD = 7.08$ ) and 14.75 ( $SD = 9.71$ ). Even if Phase 1 shows high frequencies, the rest of the data evidence a celerity that tends to be zero. In Phase 2, gradual deceleration of frequencies occurs. The trend in Phase 3 is almost zero celerity. Results show an immediate effect for the contexts of snacking and free play between Phases 1 and 2. Between Phases 2 and 3, an immediate effect is observed.

For this educator, NAP analyses show an insignificant effect between Phases 1 and 2 [ $NAP = 0.52$  ( $p = 0.84$ ), 95% CI (0.28, 0.77)]. There is a moderate and significant effect between Phases 1 and 3 [ $NAP = 0.84$  ( $p < 0.01$ ), 95% CI (0.66, 1.00)] and between Phases 2 and 3 [ $NAP = 0.78$  ( $p < 0.05$ ), 95% CI (0.60, 0.97)]. A positive evolution of *Dosage* emerges from the visual and statistical analyses between Phases 1 and 3, as well as between Phases 2 and 3.

#### *Educator C, observational data*

The average for Phase 1 is 8.83 ( $SD = 11.65$ ); the trend shows gradual deceleration in frequency of learning opportunities. Results for Phase 2 show an average of 12.25 ( $SD =$

8.60), and for Phase 3 an average 20.58 ( $SD = 12.99$ ). Between Phases 1 and 2, the effect seems immediate for snacking and structured play. For Phase 3, immediacy of effect is observed for free play and structured play only.

In terms of non-overlap analyses, Educator C's results are not significant between Phases 1 and 2 [NAP of 0.66 ( $p = 0.18$ ), 95% CI (0.43, 0.89)] and between Phases 2 and 3 [NAP = 0.70 ( $p = 0.09$ ), 95% CI (0.48, 0.92)]. A significant and moderate effect can be observed between Phases 1 and 3 for this educator [NAP = 0.78 ( $p < 0.05$ ), 95% CI (0.59, 0.97)]. There is a positive evolution between baseline and Phase 3 in the frequency of learning opportunities.

#### *Educator D, observational data*

Results of Educator D's descriptive analyses show an average of 1.75 ( $SD = 3.95$ ) for Phase 1. The respective averages for Phases 2 and 3 are 9.17 ( $SD = 5.73$ ) and 6.43 ( $SD = 3.89$ ). For Phases 1 and 2 slopes, celerity is almost nil. The trend in Phase 3 shows a more or less steep deceleration. Results show immediacy of effect between Phases 1 and 2, but not between Phases 2 and 3.

For non-overlap analyses, Educator D's results show a moderate and significant effect between Phases 1 and 2 [NAP = 0.87 ( $p < 0.01$ ), 95% CI (0.71, 1.00)] and between Phases 1 and 3 [NAP = 0.87 ( $p < 0.01$ ), 95% CI (0.71, 1.00)]. Educator D's results demonstrate an insignificant effect between Phases 2 and 3 [NAP = 0.37, ( $p = 0.26$ ), 95% CI (0.13, 0.59)]. Therefore, results of visual and statistical analyses tend to show a positive evolution of dosage between Phases 1 and 2 as well as between Phases 1 and 3.

#### *Educators A, B and D, logbook data*

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Analysis of the three educators' responses to the Likert scale indicates that their integration of learning opportunities as planned improves between Phases 2 and 3. In Phase 2, educators A and B mostly responded 'I embedded learning opportunities less often than expected', while educator D's response was mostly 'exactly as planned'. In Phase 3, the most frequent response for the three educators is 'more often than expected'.

### ***Quality***

Results are presented for each indicator: adjustment of opportunities to the group's developmental level; quality of antecedents and reinforcements/consequences.

#### *Adjustment of opportunities to the group's developmental level*

Results show that at baseline, all educators 'always' offered learning opportunities in line with their groups' developmental levels. In Phases 2 and 3, the quality of this indicator decreases slightly from 'always' to 'often' for two out of four educators. For answers to the open-ended questions in the *What I'm doing* questionnaire during Phase 1, three educators mention referring to children's interests to adjust learning opportunities. In Phase 3, one educator reported adjusting learning opportunities by referring to *Literacy Area, 0-6 years old* (EMRG, 2018). The other three educators indicated that they adjusted learning opportunities according to the children's interests. For example, one educator noted, 'Yes, the opportunities are suitable. I see it when I see their interests or not.'

#### *Antecedents and reinforcements/consequences*

According to the analyses, antecedents and reinforcements/consequences are 'always' part of ongoing interactions and are 'always' logical and natural for the three phases and the four educators. Results show that in Phase 1, only one educator performs reinforcements 'often' at the right time instead of 'always'. For the other educators, and

for all three phases, reinforcements are 'always' given at the right time, immediately after a child performs the skill.

### ***Participant responsiveness***

This indicator is measured by the observed proportion of children's responses to the antecedent of the learning opportunity. The lowest percentage of *Participant responsiveness* was observed for Educator B in Phase 1, at 77.30%. For the other three educators, the average *Participant responsiveness* percentage in Phase 1 is 95.12 ( $SD=4.76$ ). In Phase 2, the average percentage for the four educators is 93.77 ( $SD=3.62$ ) and in Phase 3, it is 93.24 ( $SD=5.36$ ).

## **Discussion**

This study provides an understanding of the implementation fidelity of naturalistic intervention practices in daycare setting. The main results for evolution of implementation fidelity of ABI intervention practices are linked to the scientific documentation on the subject. The embedded design is also used to discuss the results.

### ***Adherence***

The purpose of this study was to document the evolution of *Adherence*, that is, implementation of the important dimensions of ABI. One of these dimensions is adaptation of the environment to support young children's development. Results of this study highlight the significant increase in environmental adaptations made by educators from the beginning to the end of the study. These results present a positive perspective of the possibility of improving this important dimension of ABI intervention practices. The results are useful considering that, according to surveys of educational services in Québec

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daycare centres (Gingras et al., 2015), environmental adaptations did not adequately meet the needs of children aged 18 months and older.

### ***Dosage***

The observations suggest a positive and significant increase in learning opportunities offered by educators as a result of professional development. This positive trend is consistent with the results of Snyder et al. (2018). Those results show a rise in frequency of learning opportunities offered to young children with disabilities as a result of professional development (onsite training and coaching workshops).

Results from logbook data analyses indicate that educators report improving their integration of learning opportunities across the three study phases. The logs were used to collect data and served as checklists for educators to reflect weekly on their planned integration of learning opportunities. Therefore, this data collection tool may have enhanced this positive evolution of *Dosage*. In this regard, Wenz-Gross and Upshur (2012) note that a checklist used as a reminder can improve implementation of PIP as planned.

In the current study, there is some agreement on the positive evolution of *Dosage* between self-reported and observational data. However, other studies (Hamre et al., 2010; Lillehoj et al., 2004; Resnicow et al., 1998) show discrepancies between self-reported and observational data. In Hamre et al. (2010), information about *Dosage* reported by educators is not linked to developmental improvements in children, compared with observational data. These authors highlight the importance of using objective data collection methods such as observation.

On the other hand, it is important to emphasize that our study results are not consistent with the results of Pretti-Frontczak and Bricker (2001), who conducted a study to evaluate integration of learning opportunities by seven teachers in early childhood education or early childhood special education. In their study, for every 15 seconds of observation, occurrence or non-occurrence of learning opportunities is recorded (partial interval method). Their results show that educators integrate learning opportunities in 9.7% of observed intervals, which is less often than expected. Those results, qualified as weak by Pretti-Frontczak and Bricker, can be explained in different ways. It should be noted that in Pretti-Frontczak and Bricker's study, learning opportunities target individual children and not a group. Consequently, and compared to the main study discussed in this article, there are fewer possibilities for integrating learning opportunities. Those results could also be due to the rating method used, which may underestimate the number of opportunities implemented. Indeed, one of the shortcomings associated with the partial interval scoring method is the risk of underestimating the targeted practice (Conroy et al., 2015; Meany-Daboul et al., 2007). In our study, the method of scoring observations is based on the partial interval method, but with modifications to address this discrepancy. In practice, 15-second intervals are used for scoring, but all learning opportunities are counted and not just occurrence or non-occurrence.

### ***Quality and Participant responsiveness***

The *Quality* component refers to adjustment of opportunities to a group's developmental level as well as quality of antecedents and reinforcements/consequences. In essence, the data suggest that the learning opportunities offered are of high quality at all stages.

Nevertheless, a slight decrease in quality can be observed for two educators related to

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adapting learning opportunities to children's developmental levels. These scores could be explained by *Adherence* results and qualitative data from the *What I'm doing* questionnaire. In *Adherence* outcomes for Phase 3, only one in four educators reported using a tool to assess children's development. However, to properly adjust learning opportunities, it is necessary to have a developmental portrait of children's emerging strengths and skills. To build this portrait, it is recommended to use a developmental assessment tool that collects data on children's skills in interaction with their environments through observation (Johnson et al., 2015). In terms of *Quality*, three of the four educators 'always' utilize reinforcements and consequences in a timely manner as early as in Phase 1. Only one educator does it 'often'. In the videos, it is possible to see that this educator offers reinforcement too quickly. This result makes it possible to understand the single lower rate for *Participant responsiveness*, observed in Phase 1 for this same educator's group. Indeed, as reinforcement happens too quickly, children do not have time to demonstrate an expected ability.

Overall, our study results indicate that *Adherence*, *Dosage*, *Quality* and *Participant responsiveness* can all show general positive changes following training and coaching. The changes are also observable for all educators and can be explained by the presence of key elements associated with effective professional development. These key elements are well-detailed practices and a concrete illustration of new knowledge through exercises (Dunst & Trivette, 2009; Snyder et al., 2011). Furthermore, the dimensions of ABI are well detailed in the reference literature (Johnson et al., 2015). Also, a half-day of training is dedicated to concrete exercises that allow educators to test their new knowledge.

Our results also make it possible to identify indicators for improvement, such as evaluation of children's development (*Adherence*) and adjustment of opportunities to the group's developmental level (*Quality*). Thus, studies by Hamre et al. (2010) and Guo et al. (2016), as well as the present study all show the importance of documenting several components of implementation fidelity and not only *Dosage*. In complex intervention practices such as ABIs and other PIP in early childhood education and care (ECEC), different components influence each other. This type of PIP provides the basis for an accurate reading of children's developmental levels, identifying skills to acquire or being acquired, and generating adapted interventions. As a result, a complete assessment of fidelity is necessary and, as in the present study, allows pooling data on the implementation fidelity of various components. With pooled data it is possible to provide feedback to educators on improving their practices. However, this study has some limitations.

### **Limitations of the study**

First, the study design does not meet all the quality criteria for single-case research, as described by Kratochwill et al. (2013). Use of a multiple baseline design would have met all these criteria, but the context of the study (requirements of the participating environments) did not allow it. The design still makes it possible to address the purpose of the study, that is, to document the evolution of implementation fidelity. The single-case research design used also provides relevant insights. Results of the visual and statistical analyses suggest professional development has a positive effect on frequency of the embedded learning opportunities. Second, due to the absence of measures in the



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maintenance phase, it is not possible to know whether these observed changes persist over time, which is a limitation of this study. Finally, it is important to note a possible social desirability effect related to the many observation moments.

## **Conclusion**

Although the present study focuses specifically on ABI, the systematic method developed could be used to implement other PIP in ECEC. This method is used to collect data during the implementation process and could be used for formative assessments. The latter aim to rapidly bring to light difficulties when implementing PIP so the setting can make the adjustments needed (Chen, 2015). Data collection tools and methods developed for a research context could also be useful for professional development in ECEC. For example, direct observation data of intervention practices combined with perceptual data from logbooks could be used in a professional supervision process in daycare centres, preschool classrooms or specialized early intervention services. The knowledge produced in this study could be used to support implementation fidelity of ABI and other PIP in ECEC. This knowledge is important, given the well-documented link between high fidelity of implementation of PIP in ECEC determined to be effective and the positive effects on children's development.

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