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# Measuring level of service Integration within ECEC child centers: development and validation of the Index for child center Integration

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**ABSTRACT**

In early childhood education and care, professionals from childcare, education, and family support services engage in interprofessional collaboration. In this study, we present the background and development of the newly developed Index for Child Center Integration (ICCI), a comprehensive instrument designed to measure the level of collaboration at the organizational level between childcare, education, and family support services from the perspective of childcare and education. Interviews with managerial staff of 46 Dutch child centers were used to investigate the factor structure and evaluate the reliability of the ICCI. In addition, 788 professionals completed a social network questionnaire to assess interprofessional collaboration at individual level. A factor analysis revealed a two-factor solution: interprofessional collaboration for universal and targeted services. The ICCI demonstrated good reliability (Cronbach's α is .92 for the overall measure, universal scale: .94, targeted scale: .80). The results of the social network analysis supported convergent validity. The new measure allows in-depth investigation of interprofessional collaboration of various early years practitioners in future research.

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## Introduction

The integration of early childhood education and care (ECEC) services has been advocated to ensure smooth transitions from preschool to school and to optimize care for children with special needs (Barnes et al., 2018; Curran et al., 2014). This collaborative approach aims to foster children's broad development in their early years and to reduce inequalities at an early age (Lazzari et al., 2020). In pursuit of integration, ECEC organizations – including childcare, primary education, and family support services – have started collaborating to offer a broad range of services for a diverse population of children and their families. Such integration and interprofessional collaboration (IPC) at the local level is a new phenomenon in various countries (Ooms et al., 2025). This new and dynamic context for ECEC institutions and their staff requires new empirical research into IPC, including the development and validation of new measures.

Interprofessional collaboration to integrate ECEC services is multi-dimensional (Verheijen-Tiemstra et al., 2020) and focuses on three domains. First, there may be significant discontinuities in the transitions from childcare to school (Lazzari et al., 2020), which may hinder childrens' development (Barnes et al., 2018). Interprofessional relationships can alter professionals' beliefs and create opportunities for continuity during this transition (Cook et al., 2017). Secondly, out-of-school care has become an important socialization environment for a rapidly growing number of children (Fukkink & Boogaard, 2020; Keuning et al., 2022), yet there is little alignment between school and out-of-school care (Keuning et al., 2022). Thirdly, there is a lack of accessible services for children with special needs in mainstream ECEC (Woolfson, 2024). Integration between childcare, school, and family support may provide inclusive services for children with special needs and their families (Barnes et al., 2018; Sun et al., 2024). To facilitate collaboration on these domains, professionals engage with colleagues from other disciplines to develop shared objectives (Langner & Fukkink, 2022; Ooms et al., 2025; Ranta et al., 2023). Finally, a fourth dimension of collaboration involves discussing a shared vision and policy at the center level.

A challenge in educational research is that studies on IPC within ECEC rely on instruments originally developed for the health sector, with a notable lack of validated tools. At the professional level, some progress has been made with validated instruments such as the PINCOM-Q (Ødegård, 2006) and the Index for Interdisciplinary Collaboration (IIC; Bronstein, 2002), used to assess professionals' attitudes toward IPC. However, at the organizational level, there remains an absence of validated instruments to measure the degree of service integration, including collaboration with family support services and care providers, which is important for inclusive education (Barnes et al., 2018; Sun et al., 2024).

### *Social network analysis in ECEC*

Social network analysis provides insights into the structure of professional networks (Borgatti et al., 2009; Wölfer et al., 2015)

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like the level of collaboration within a child center. In this context, density reflects the number of observed ties among network members (Wasserman & Faust, 1994; Wölfer et al., 2015), indicating the overall connectedness within an interprofessional team. Edgewise reciprocity involves the number of reciprocated relationships, which reflects mutuality of relations within a team (Wölfer et al., 2015). Previous research revealed that professional networks of Dutch child centers exhibited high levels of reciprocity and a modest level of density between professionals with relatively little interprofessional collaboration (Fukkink & van Verseveld, 2020).

### The Dutch ECEC context

Countries have significantly different systems of childcare, primary education, and family support. The Dutch system is characterized by different ministries responsible for education, childcare, and family support, different laws and regulations for each sector, and varying levels of qualification for professionals in the different sectors. Hence, the Netherlands has a so-called "split system" at macro level (Eurydice, 2025), which is a barrier for interprofessional collaboration in local networks (Keuning et al., 2022). In practice, there is significant variation in integration at the local level. Childcare and primary education may operate independently in traditional centers, whereas other innovative centers have started to collaborate closely on a regular basis to offer more integrated services, sometimes also integrating family support services.

In the Netherlands, ECEC workforce staff primarily consist of Early Childhood Pedagogy Professionals and teaching assistants with an ISCED 2011 level 3 or 4 certificate, Pre-primary and Primary Education professionals with a level 5 or 6 certificate. In a coordinating role, pedagogical coaches and special needs coordinators support professionals in their work with children and parents (see Oberhuemer & Schreyer, 2024). In addition, ECEC child centers collaborate with professionals from welfare, youth healthcare and paramedical services.

At 71.5%, the childcare attendance rate for children under three is in the Netherlands above the EU target of 45%. However, the 92% attendance rate for children over three is below the EU target rate (Eurydice, 2025). Primary education is compulsory from the age of five, but most children enroll in primary education at the age of four (95%) (Oberhuemer & Schreyer, 2024). Further, 16% of the children attend out-of-school care (Fukkink & Boogaard, 2020).

### Present study

In this study, we report the development and validation of the new Index for Child Center Integration (ICCI), which measures the degree of service integration within ECEC centers at the organizational level. We focus on the reliability and psychometric structure of the ICCI as well as its convergent validity.

Since the ICCI aims to measure the degree of service integration at the organizational level, we investigated its convergent validity by analyzing the relation between the ICCI and (inter)professional networks with social network analysis. Social network analysis provides insight into teamwork and the complexity of IPC (Borgatti et al., 2009; Wölfer et al., 2015) with a focus on the network as a whole (i.e., topology) and the dyads (i.e., relationships) in a network (Casciaro et al., 2015). We analyzed whether centers with a higher level of integration between childcare, school, and/or family support services, as measured with the ICCI, have more dense and more reciprocal (inter)professional relations between professionals.

## Method

### Sample

A total of 46 centers participated from 11 (out of 12) provinces in the Netherlands. Altogether, 1,202 professionals were invited to complete an online questionnaire and 788 respondents participated, resulting in a response rate of 65.6% (response rates per center ranged from 20 to 90%). The majority of the professionals worked in primary education (51.9%), followed by childcare (39.7%). A small number of professionals was engaged in family support services, welfare, or youth healthcare (1.6%); some professionals from family support services indicated that they did not consider themselves part of the team to participate in the survey. Characteristics were analyzed based on available data (gender: $N = 622$; age: $N = 628$; educational level: $N = 550$), with 91.3% being female. Furthermore, 30.7% of the professionals were aged between 31 and 40, and 24.5% between 41 and 50. The majority of the professionals held an ISCED 2011 level 6 certificate (52.2%), followed by a level 4 certificate (22.3%).

### Measures

*Index for Child Center Integration (ICCI)*. This newly developed measure charts the level of integration between childcare, primary education, and family support services on organizational level with 22 items (e.g., "Pedagogical relations," "Collaboration with specialized care," see Supplementary Material A for an overview). Each item was scored during an interview by the management team and a researcher together on a three-point scale: separated (1), coordinated (2) or integrated (3).

*Social network questionnaire*. We developed this questionnaire to assess the (interprofessional) collaboration among professionals on individual level from each center. The social network questionnaire addressed four domains: the transition of a child from childcare to school (a one-time transition); the transition of a child from school to out-of-school care (a daily transition); collaboration related to children's special needs (hereafter referred to as care); and coordination of pedagogical and didactical continuity in the policy of the location (hereafter referred to as policy). To measure the intensity of collaboration in these areas, the questionnaire included two time frames: "With whom did you collaborate in the last five weeks?," which offers insight into high frequent interactions, and "With whom did you collaborate in the last six months?," which provides insight into low frequent interactions. The questionnaire was personalized, and each participant could select the colleagues they worked with for each domain and time frame.

### Development of the Index for child center integration (ICCI)

The development of the ICCI was guided by the methodological framework outlined by Stefana et al. (2025), which emphasizes the importance of grounding the instrument in a robust theoretical framework and subsequent empirical foundation. Below we address a definition of key constructs, item generation, and the assessment of the measure's reliability and validity.

### Item development phase

In our definition of the construct, we distinguished four domains for IPC (see Introduction): transitions from childcare to school, alignment between school and out-of-school care, providing inclusive services for children with special needs, and discussing a shared vision and policy at the center level. Subsequently, we developed items in close collaboration with field experts and organized biweekly research meetings over a four-month period to ensure iterative refinement and consensus within the research group.

An initial set of 10 items was based on Verheijen-Tiemstra et al. (2020), as well as insights derived from two Dutch reports that explored inter-organizational collaboration (Sardes, 2017; Veen et al., 2019) to comprehensively address the collaboration between childcare and primary education. Furthermore, we expanded the scope of the collaboration with five additional items related to the collaboration of childcare and education with external family support and care professionals, based on the Multi-tiered System of Support (Nitz et al., 2023). These items encompass collaboration with partners from the community, preventive (health)care, social work, and specialized professionals such as therapists and paramedical practitioners (Sun et al., 2024). During the developmental process several revisions on item-descriptions were made, but no items were removed since all items were theoretically supported by our conceptual model and represented important aspects of ECEC service integration.

To determine an appropriate scaling for the instrument, we reviewed related frameworks (e.g., Boon et al., 2004; Valentijn et al., 2013; Verheijen-Tiemstra et al., 2020), including frameworks at the national level, such as Eurydice (2025) and SEEPRO3 (Oberhuemer & Schreyer, 2024). Considering the need for clarity, ease of use, and the capacity to distinguish meaningful levels of collaboration for stakeholders in ECEC practice, we ultimately selected a response scale for items with three levels: separate (1), coordinated (2) and integrated (3). This scale balances simplicity with sufficient differentiation, allowing respondents and researchers to provide a clear assessment of collaboration across the various subdimensions at the item level.

The data collection with the ICCI is based on a one-hour interview between the managerial staff from a center (i.e., school principal and childcare manager) and an external researcher through a semi-structured interview guideline. In this interview, participants scored their level of integration together with the researcher and gave examples. This format enabled a systematic, in-depth discussion of vision, policy and practice related to the collaboration between professionals from childcare, education, and various other services and service integration. In total, 51 interviews were conducted between March and June 2023. All interviews were audiotaped and transcribed by a researcher.

A blinded research assistant independently rated the transcripts from 14 (out of 51) centers. To assess interrater reliability, the item scores from the interviews with ECEC management were compared with those of the research assistant. The agreement was substantial, as indicated by an unweighted Cohen's kappa of 0.68. The analysis also identified ambiguous phrases in the coding scheme, which we revised to enhance clarity. For instance, item 1 we clarified level 3 by adding *these are written down and professionals act accordingly* to the original description: "*The child center has a joined pedagogical vision and guiding principles*."

Finally, all transcripts were systematically reviewed based on the revised coding scheme. In the event of uncertainty, supplemental consultations were conducted with the respective locations to ensure accuracy and consistency in assigning scores; five centers dropped out without complete data according to the final instrument and therefore could not be included. Consequently, only 46 centers were included in the second phase of the study. In this phase, we evaluated the psychometric structure, reliability, and validity of the ICCI.

### Procedure

In the spring of 2023, researchers from four universities of applied sciences (Amsterdam University of Applied Science, Hanze University of Applied Science, University of Applied Science KPZ, and Zuyd University of Applied Science) contacted their regional networks and used social media (e.g., LinkedIn) to recruit centers. During the recruitment phase, we monitored whether the participating centers represented a broad range of service integration, varying from traditional centers to fully integrated child centers, based on the intake meeting with a representative of the center and a researcher.

At the start of the data collection (spring 2023), we conducted face-to-face interviews with the managerial staff from a center to assess their level of service integration at center level (i.e., the ICCI score). Each center, subsequently, provided a list of professionals, including their discipline and involvement in childcare or education for children aged between 2 and 7 years. In summer and fall 2023, each professional received a link to a personalized social network questionnaire to measure interprofessional collaboration of all individual professionals from each center (see Measures). Four reminders were sent over a period of 2 months.

Prior to data collection, the review board of the University of Amsterdam approved the research plan (FMG-1422). Each participant gave informed consent at the start of the questionnaire. Also, we preregistered our hypotheses in the Open Science Framework (see https://doi.org/10.17605/OSF.IO/7PQ4V).

### Analyses

#### Psychometric structure and reliability analyses

To assess the scale structure of the ICCI, we used principal axis factoring (PAF) with promax rotation to test a one-factor and

two-factor structure. The analyses were executed using the fa-function from the psych package in R (Revelle, 2025; R Core Team, 2021). For the two-factor structure, we assigned each item to the component with the highest loading. We assessed the assumption of multivariate normality.

The reliability of the ICCI was evaluated by calculating Cronbach's alpha for the total ICCI scale and two identified components using the alpha function from the psych package in R (Revelle, 2025). A Cronbach's alpha coefficient of 0.70 or higher was considered indicative of acceptable reliability.

### Validity analyses

For the validity analyses we used the data from the social network questionnaire in social network analyses on both organizational and dyadic level. For this, eight network matrices were created, based on the four domains and the two time frames of the questionnaire. Only complete dyads (i.e., with participation of both professionals in the survey) were used. Furthermore, we calculated mean ICCI-scores of all scales and corresponding grand-mean centered scores, which were used in the analyses.

For the analyses at organizational level, the R package SNA (Butts, 2008) was used to calculate the density and edgewise reciprocity score for the eight networks of all centers. In this package, the density score is the number of ties divided by the number of possible ties, which indicates the probability of a contact in each network. Edgewise reciprocity is the proportion of observed ties that is reciprocated, which reflects the probability that a relation is mutual (versus being unreciprocated). The eight density and edgewise reciprocity scores for each center were correlated (Pearson's correlation) with the mean ICCI scores. In a preliminary analysis, we verified the assumption of linearity and checked for outliers without finding major violations.

For the analysis on dyadic level, we used the multilevel $j_2$ model (Zijlstra, 2017) in the R package dyads. In the $j_2$ model, the density parameter represents the probability of a single tie (i.e., the log odds of a relation between two professionals). The reciprocity parameter represents the degree to which relations in dyads are more symmetric than can be expected based on the density (i.e., the ratio of the odds of a reciprocal dyad versus an asymmetric dyad and the odds of an asymmetric dyad versus a null dyad). In the $j_2$ model, the density and reciprocity parameters are independent. Furthermore, the $j_2$ model allows the inclusion of covariates. Several variables were created for this analysis. The list of professionals with their discipline(s) (childcare, education, or care) was used to create a matrix with interprofessional dyads to assess *inter*professional collaboration (all interprofessional dyads were scored 1). To evaluate the interaction effect of the ICCI scores and interprofessional dyads, we created a matrix with this interaction effect (i.e., interprofessional dyad*ICCI score).

Two models were assessed for all networks. The initial Model 1 encompassed the covariates for both the density and reciprocity effects: interprofessional dyads, the ICCI *Total* score, and the interaction effect of interprofessional dyads with the ICCI *Total* score. Model 2 was identical to the first model except that the ICCI *Total* was replaced by the two subscales, with corresponding interaction effects modeled separately for each subscale.

The *j2* model is a dyadic model. Prior to analyzing the data we assessed the triad census of the networks (Davis & Leinhardt, 1972) to check whether there was a high frequency of triadic configurations that may affect the *j2* model. All were of low frequency and, therefore, we proceeded with modeling.

## Results

### Psychometric structure and reliability of the ICCI

The one-factor solution showed all positive item loadings, ranging from 0.21 to 0.88 with an eigenvalue of 8.50, which explained 38.6% of the variance. The two-factor solution showed component loadings ranging from −0.20 to 0.90. Furthermore, the two-factor structure yielded an eigenvalue of 7.50 for the first factor, which explained 34.1% of the total variance. The second factor had an eigenvalue of 2.94 and explained 13.4% of the variance.

Theoretically, two subscales might be distinguished: one measuring collaboration between childcare and school and one measuring external collaboration. However, two items related to external collaboration (i.e., item 13, "Collaboration with welfare partners in the neighbourhood (Childcare)"; and item 14, "Collaboration with welfare partners in the neighbourhood (Elementary school)" scored highest on factor 1 (see Table 1) and these items were therefore assigned to factor 1. Conceptually, this adaptation fits in with the Multi-Tiered System of Support (Nitz et al., 2023), related to a comprehensive array of universally accessible resources within the community. Consequently, two subscales can be defined: a *Universal scale*, comprising 14 items and a *Targeted scale* with a total of eight items. The first focuses on collaboration in a universal context for all children, the second focuses on collaboration as part of a targeted approach for children with special needs. Furthermore, item 4 showed cross-loadings (see Table 1). This item was assigned to the *Universal scale* because continuity in transitions is conceptually important for all children, not only for those at risk. Finally, item 21 showed a weak loading (0.38) on the *Targeted scale*, but was retained because collaboration with paramedical professionals, although not relevant for all children, represents an important form of specialized support for some children with special needs (Sun et al., 2024).

The reliability of ICCI *Total, Internal* and *Targeted* was high (*Total*: Cronbach's α = .92; *Universal*: α = .94; *Targeted*: α = .80). The fit indices were slightly above the conventional threshold of 0.10 (Hu & Bentler, 1999). However, it is not uncommon to proceed with these scores in PAF, particularly when theoretical considerations and high reliability support the factor structure. Subsequently, we proceeded the validation process with the ICCI *Total* and *Universal* and *Targeted* subscales.

### Validity of the ICCI

At organizational level, the centers in this study had, on average, a medium level of integration, as measured with the ICCI

**Table 1.** Component loadings and model fit indices of the one and two-factor solution.

| | | | Two Factor solution | |
|---|---|---|---|---|
| | | One factor solution | Universal | Targeted |
| 1 | Pedagogical vision | 0.87 | **0.87** | 0.03 |
| 2 | Pedagogical relationship | 0.83 | **0.90** | −0.07 |
| 3 | Atmosphere and rules of manner | 0.75 | **0.84** | −0.11 |
| 4 | Continuity in learning and development: transition moments. Daycare to school | 0.75 | **0.55** | 0.33 |
| 5 | Continuity in learning and development: transition moments. School to out-of-school care | 0.66 | **0.64** | 0.06 |
| 6 | Continuity in learning and development: learning content. Daycare to school | 0.78 | **0.75** | 0.07 |
| 7 | Continuity in learning and development: learning content. School to out-of-school care | 0.64 | **0.70** | −0.07 |
| 8 | Interprofessional collaboration for identification of needs and provision of care | 0.75 | **0.63** | 0.21 |
| 9 | Professionalization | 0.73 | **0.71** | 0.05 |
| 10 | Joint ambition | 0.73 | **0.82** | −0.10 |
| 11 | Collaboration on board level | 0.58 | **0.72** | −0.18 |
| 12 | Organizational appearance | 0.68 | **0.84** | −0.20 |
| 13 | Collaboration with welfare partners in the neighbourhood (Childcare) | 0.60 | **0.53** | 0.12 |
| 14 | Collaboration with welfare partners in the neighbourhood (School) | 0.56 | **0.46** | 0.17 |
| 15 | Prevention and early intervention (Childcare) | 0.48 | 0.13 | **0.57** |
| 16 | Prevention and early intervention (School) | 0.46 | 0.10 | **0.58** |
| 17 | Collaboration partners from family support (Childcare) | 0.60 | 0.18 | **0.68** |
| 18 | Collaboration partners from family support (School) | 0.57 | 0.20 | **0.59** |
| 19 | Specialized care (Childcare) | 0.28 | −0.12 | **0.62** |
| 20 | Specialized care (School) | 0.21 | −0.20 | **0.64** |
| 21 | Collaboration with paramedical professionals (Childcare) | 0.23 | −0.01 | **0.38** |
| 22 | Collaboration with paramedical professionals (School) | 0.21 | −0.10 | **0.48** |
| Eigenvalue | | | 7.56 | 3.00 |
| Proportion of Variance | | | 0.34 | 0.14 |
| $\chi^2$ (df) | | 854.93 (209) | 854.93 (188) | |
| RMSR | | 0.15 | 0.12 | |
| RMSEA (90% CI) | | 0.18 (0.16–0.20) | 0.17 (0.15–0.19) | |
| Factor Correlation | | – | 0.47 | |

Note: For the two-factor analysis, highest loadings are marked in bold.

*Total*, with an average score of 2.0 (*SD* = 0.47) on a scale from 1 to 3. However, individual scores ranged from low (i.e., indicating no collaboration) to high (i.e., indicating integrated services) (range: 1.0–2.9). The average score of the subscale *Universal* was 2.0 (*SD* = 0.57; range 1.0–2.9), slightly higher than subscale *Targeted* average score of 1.9 (*SD* = 0.44; 1.0–2.8).

### *Relation between ICCI and density and edgewise reciprocity at center level*

The analyses of the correlation between the ICCI *Total* and density and reciprocity scores for the networks revealed that nearly all correlations were positive, indicating a positive relation between the ICCI *Total* score and collaboration at the center level. For the five-weeks networks, there was a significant association between the ICCI *Total* score and the density of transition from school to out-of-school care, $r(44) = .37$, $p = .013$, and edgewise reciprocity of care, $r(44) = .45$, $p = .002$. In the six-months networks, three correlations were statistically significant: the density of transition from childcare to school, $r(44) = .51$, $p < .001$; and care, $r(44) = .33$, $p = .027$; and the edgewise reciprocity of care, $r(44) = .32$, $p = .029$ (see Table 2). Thus, as the ICCI *Total* score increases, the networks for the transition from school to out-of-school care (5 weeks) and care for children with special needs (6 months) became denser. Furthermore, the relationships were more often reciprocal for the transition from childcare to school (6 months) and care for children with special needs (5 weeks and 6 months).

The ICCI *Universal* was positively related to the density of the five-weeks networks of transition from school to out-of-school care, $r(44) = .44$, $p = .002$; and the density of the six-months networks of transition from school to out-of-school care, $r(44) = .37$, $p = .012$; care, $r(44) = .34$, $p = .020$; and policy, $r(44) = .32$, $p = .027$. In addition, ICCI *Universal* was positively correlated with edgewise reciprocity in the five-weeks networks of transition from childcare to school, $r(44) = .49$, $p = .001$, the transition from school to out-of-school care, $r(44) = .34$, $p = .025$; and care, $r(44) = .31$, $p = .035$. Furthermore, the ICCI *Targeted* was positively related to the edgewise reciprocity of the five-weeks networks of care, $r(44) = .38$, $p = .019$, as well as the six-month networks of the

**Table 2.** Pearson's correlations between ICCI Total and density and reciprocity of networks.

| | | Five weeks | Six months |
|---|---|---|---|
| Transition childcare to school | Density | .17 | .07 |
| | Edgewise reciprocity | .28 | .51*** |
| Transition school to out-of-school care | Density | .37* | .27 |
| | Edgewise reciprocity | .15 | .28 |
| Care | Density | .23 | .33* |
| | Edgewise reciprocity | .45** | .32* |
| Policy | Density | .23 | .23 |
| | Edgewise reciprocity | −.03 | .26 |

Note: df = 44; * = p ≤ .05; ** = p ≤ .01; *** = p ≤ .001.

transition from childcare to school, $r(44) = .34$, $p = .020$ (see Supplementary Material B, Table B1). Thus, as the ICCI *Universal* score increases, the networks for the transition from school to out-of-school care and care (5 weeks and 6 months), care and policy (6 months) became denser. In addition, contacts were more often reciprocal for the transition from childcare to school and school to out-of-school care and care (5 weeks). Finally, as the ICCI *Targeted* score increases, contacts for care (5 weeks) and transition from childcare to school (6 months) were more often reciprocal.

### Relation between ICCI and density and reciprocity at dyadic Level

***Transition from childcare to school.*** The Model 1 analyses of the five-weeks networks for transition from childcare to school demonstrated a negative density effect for interprofessional dyads and a positive interaction effect for the density of interprofessional dyads and ICCI *Total* score. Thus, in their five-weeks contacts, professionals collaborated less often with colleagues from a different discipline about the transition from childcare to school compared to collaboration within their own discipline (for an average ICCI *Total* score), but professionals in a center with a higher ICCI *Total* score (i.e., above average) were relatively more often engaged in interprofessional collaboration. The analyses of the six-months networks with the ICCI *Total* score only revealed a negative density effect for interprofessional dyads (see Table 3).

The Model 2 analyses for the five-weeks networks demonstrated a negative density effect and a positive reciprocity effect for interprofessional dyads. Furthermore, the six-months networks revealed a positive interaction effect for the density of interprofessional dyads with the *Universal* scale and a negative interaction effect for the reciprocity of interprofessional dyads with the *Targeted* scale (see Supplementary Material B, Table B2).

***Transition from school to out-of-school care.*** The Model 1 analyses of the five-weeks networks for transition from school to out-of-school care demonstrated a negative density effect for interprofessional dyads and a positive interaction effect for the density of interprofessional dyads and ICCI *Total* score. The analyses of the six-months networks only revealed a positive interaction effect for the density of interprofessional dyads and ICCI *Total* score (see Table 4).

The Model 2 analyses for the five-weeks networks demonstrated a negative density effect for interprofessional dyads and a positive interaction effect for the density of interprofessional dyads and the *Universal* scale. Furthermore, the six-months networks revealed a positive interaction effect for the density of interprofessional dyads with the *Universal* scale (see Supplementary Material B, Table B3).

**Table 3.** $J_2$ML models for transition from childcare to school.

| | | Five weeks | | Six months | |
|---|---|---|---|---|---|
| Effect | Covariate | Est. | SE | Est. | SE |
| Density | | −4.85** | 0.24 | −4.26** | 0.29 |
| | Interprofessional dyad | −0.37** | 0.13 | −0.13** | 0.11 |
| | ICCI score | −0.25 | 0.80 | −0.35 | 1.34 |
| | Interprofessional dyad*ICCI score | 0.49* | 0.23 | 0.51 | 0.27 |
| Reciprocity | | 1.79** | 0.61 | 1.92** | 0.50 |
| | Interprofessional dyad | 0.00 | 0.68 | −0.46 | 0.52 |
| | ICCI score | −0.20 | 1.74 | −0.40 | 1.78 |
| | Interprofessional dyad*ICCI score | −0.72 | 1.69 | 0.16 | 1.20 |
| *Random effects* | | | | | |
| Sender variance | | 3.81 | 0.65 | 5.82 | 0.98 |
| Receiver variance | | 1.35 | 0.36 | 2.50 | 0.69 |
| Sender-receiver covariance | | 1.85 | 0.36 | 2.70 | 0.60 |
| Density variance | | 1.38 | 0.50 | 2.34 | 0.72 |

Note: * = p ≤ .05; ** = p ≤ .01.

**Table 4.** $J_2$ML models for transition from school to out-of-school care.

| | | Five weeks | | Six months | |
|---|---|---|---|---|---|
| Effect | Covariate | Est. | SE | Est. | SE |
| Density | | −5.50** | 0.22 | −4.87** | 0.21 |
| | Interprofessional dyad | −0.48** | 0.17 | −0.24 | 0.12 |
| | ICCI score | −0.05 | 1.91 | 0.20 | 0.81 |
| | Interprofessional dyad*ICCI score | 0.96** | 0.37 | 0.70** | 0.24 |
| Reciprocity | | 1.34** | 0.54 | 1.49** | 0.49 |
| | Interprofessional dyad | −0.20 | 1.40 | 0.17 | 0.74 |
| | ICCI score | −0.10 | 1.93 | 0.06 | 1.58 |
| | Interprofessional dyad*ICCI score | −0.51 | 2.40 | 0.89 | 1.51 |
| *Random effects* | | | | | |
| Sender variance | | 2.97 | 0.86 | 4.03 | 0.62 |
| Receiver variance | | 0.65 | 0.65 | 0.69 | 0.42 |
| Sender-receiver covariance | | 1.95 | 1.37 | 1.70 | 0.39 |
| Density variance | | 0.89 | 0.39 | 0.84 | 0.49 |
| Reciprocity variance | | 0.32 | 0.25 | 0.23 | 0.14 |

Note: * = p ≤ .05; ** = p ≤ .01.

***Collaboration on care for children with special needs.*** The Model 1 analyses of the five-weeks networks for care demonstrated again a negative density effect for interprofessional dyads and a positive interaction effect for the density of interprofessional dyads and ICCI *Total* score. The analysis of the six-months networks of care showed a negative density effect for interprofessional dyads and for the *Total* score as well as a positive interaction effect for the density of interprofessional dyads and *Total* score. Thus, in their six-months contacts, professionals collaborated less with colleagues from another discipline in the context of care for children with special needs compared to collaboration within their own discipline (for an average *Total* score), and professionals within centers with a higher *Total* score collaborated relatively less with other colleagues. Again, in centers with a higher level of integration, professionals were relatively more often engaged in interprofessional collaboration (see Table 5).

The Model 2 analyses for the five-weeks networks demonstrated a negative density effect for interprofessional dyads and a positive interaction effect for the density of interprofessional dyads with the *Universal* scale and with the *Targeted* scale. Furthermore, the six-months networks revealed negative density effect for interprofessional dyads and a positive interaction effect for the density of interprofessional dyads with the *Universal* scale (see Supplementary Material B, Table B4).

***Collaboration in context of policy.*** The Model 1 analyses of the five-weeks networks for policy demonstrated a negative density and reciprocity effect for interprofessional dyads and for ICCI *Total* score and a positive interaction effect for the density of interprofessional dyads and *Total* score. Thus, professionals tended to collaborate less with colleagues from other disciplines in the policy domain compared to collaboration within their own discipline. Interprofessional relations were asymmetrical more often. Furthermore, professionals within centers with a higher *Total* score collaborated less with other colleagues, whereas professionals in centers with a higher *Total* score met more often with professionals with a different background. The analyses of the six-months networks showed again a negative density effect for interprofessional dyads and a positive interaction effect for the density of interprofessional dyads and the *Total* score (see Table 6).

The Model 2 analyses for the five-weeks networks demonstrated a negative density and reciprocity effect for interprofessional dyads and a positive density effect for the *Universal* scale. Furthermore, the six-months networks revealed a negative density effect for interprofessional dyads and a positive interaction effect for the density of interprofessional dyads with the *Universal* scale and a negative interaction effect for the reciprocity of

**Table 5.** $J_2$ML models for care for children with special needs.

| | | Five weeks | | Six month | |
|---|---|---|---|---|---|
| Effect | Covariate | Est. | SE | Est. | SE |
| Density | | −3.12** | 0.16 | −2.71** | 0.17 |
| | Interprofessional dyad | −1.96** | 0.10 | −1.92** | 0.08 |
| | ICCI score | −0.21 | 0.09 | −0.28** | 0.03 |
| | Interprofessional dyad*ICCI score | 1.26** | 0.21 | 1.09** | 0.35 |
| Reciprocity | | 2.34** | 0.52 | 2.65** | 0.54 |
| | Interprofessional dyad | −0.22 | 0.54 | −0.01 | 0.41 |
| | ICCI score | 0.00 | 1.47 | −0.18 | 1.58 |
| | Interprofessional dyad*ICCI score | −0.49 | 0.98 | −0.34 | 0.77 |
| *Random effects* | | | | | |
| Sender variance | | 3.22 | 0.56 | 4.70 | 0.82 |
| Receiver variance | | 0.76 | 0.20 | 1.07 | 0.31 |
| Sender-receiver covariance | | 1.07 | 0.20 | 1.32 | 0.29 |
| Density variance | | 0.63 | 0.22 | 0.63 | 0.24 |
| Reciprocity variance | | 0.96 | 0.46 | 1.70 | 0.44 |

Note: * = p ≤ .05; ** = p ≤ .01.

**Table 6.** $J_2$ML models for policy collaboration.

| | | Five weeks | | Six months | |
|---|---|---|---|---|---|
| Effect | Covariate | Est. | SE | Est. | SE |
| Density | | −3.84** | 0.19 | −3.15** | 0.20 |
| | Interprofessional dyad | −2.16** | 0.11 | −2.22** | 0.10 |
| | ICCI score | −0.31** | 0.12 | −0.27 | 0.22 |
| | Interprofessional dyad*ICCI score | 0.64* | 0.26 | 0.83** | 0.23 |
| Reciprocity | | 2.36** | 0.63 | 2.16** | 0.46 |
| | Interprofessional dyad | −1.45* | 0.66 | 0.12 | 0.43 |
| | ICCI score | 0.61 | 1.86 | 0.44 | 1.11 |
| | Interprofessional dyad*ICCI score | 0.27 | 1.37 | −0.15 | 0.90 |
| *Random effects* | | | | | |
| Sender variance | | 5.29 | 0.97 | 6.13 | 1.22 |
| Receiver variance | | 0.91 | 0.70 | 1.02 | 0.38 |
| Sender-receiver covariance | | 1.39 | 0.73 | 1.28 | 0.22 |
| Density variance | | 0.76 | 0.29 | 1.08 | 0.34 |
| Reciprocity variance | | 0.37 | 0.25 | 0.51 | 0.27 |

Note: * = p ≤ .05; ** = p ≤ .01.

interprofessional dyads with the *Targeted* scale (see Supplementary Material B, Table B5).

## Discussion

In this study, we reported the background and development of the ICCI, which was designed to measure the level of integration between childcare, education, and family support services. Thus far, there was no validated instrument to assess level of service integration within the Dutch ECEC context. Our instrument includes collaboration with family support services, distinguishes between types of childcare (daycare and out-of-school care) and distinguishes three levels. In this study, we presented the first steps toward a reliable and valid instrument for measuring the degree of service integration at the organizational level within ECEC.

In a national sample, a factor analysis showed two factors underlying the ICCI (i.e., *Universal* and *Targeted*). The inter-rater reliability proved adequate, and the reliability of the total scale and both subscales was good. Further, the findings of this study provided support for the convergent validity of the new instrument. The results of a social network analysis demonstrated a significant association between ICCI scores at center level and dyadic professional level.

The dyadic network structures from individual centers exhibited strong variation for the distinguished domains, which demonstrates the multi-dimensional nature of IPC in Dutch child centers (Verheijen-Tiemstra et al., 2020). In short-term contacts, professionals tend to work more with colleagues from the same discipline than with professionals from other disciplines. However, professionals in a center with a higher ICCI score worked relatively more often in an interprofessional fashion for all four themes, which was also observed in their long-term contacts.

The ICCI was originally developed to measure the integration at organizational level for research purposes. However, the ICCI may also provide policy and practice the opportunity to monitor the collaboration between childcare, education, and family support services at organizational level. At the center level, the measure can facilitate individual centers by jointly determining ambitions for collaboration. Subsequently, the measure may be used to monitor progress in a next phase. The ICCI enables monitoring and evaluating the collaboration on a larger scale at both board and local level. To promote the utilization of the ICCI in research and practice, a Dutch version of the ICCI has been made freely accessible (Kassenberg et al., 2024) and the theoretical underpinnings of the ICCI, which align with an international context, suggest that the ICCI may also be used in international contexts.

### *Limitations of this study*

Notwithstanding the encouraging findings regarding the reliability and validity of the ICCI, it is important to address certain limitations of our study. First of all, while the study aimed to focus on a sample of professionals from childcare, education, and family support services, only a small percentage of the participants were employed in family support services, youth healthcare, or paramedical care. Consequently, future research should concentrate on IPC in ECEC in conjunction with other disciplines. Secondly, the present study evaluated the convergent validity of the ICCI with a focus on (inter)professional network structures. Subsequent research may broaden the empirical support for its validity by adding a new focus on discriminant and predictive validity of the instrument. Finally, although the ICCI is embedded within the international literature, its use in an international context needs further evaluation.

## Author contributions

CRediT: **Marian Ooms:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Validation, Writing – original draft, Writing – review & editing; **Bonne Zijlstra:** Conceptualization, Formal analysis, Methodology, Software, Supervision, Validation, Writing – original draft, Writing – review & editing; **Emma Nitert:** Conceptualization, Investigation, Writing – review & editing; **Annelies Kassenberg:** Conceptualization, Investigation, Writing – review & editing; **Ruben Fukkink:** Conceptualization, Formal analysis, Funding acquisition, Methodology, Supervision, Validation, Writing – original draft, Writing – review & editing.

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## Data availability statement

The data that support the findings of this study are available from the corresponding author, Marian Ooms, upon reasonable request.

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