

Research Paper

Effect of Solitary and Group Purposeful Movement Plays on Various Aspects of Theory of Mind in Girls Aged 8 years



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ABSTRACT

**Background and Aims** Solitary movement plays have been reported to be effective in improving the primary aspects of Theory of Mind (ToM), and the design of interventions based on interpersonal interactions has been emphasized to influence the advanced aspects of ToM. To test this hypothesis, the effect of solitary and group purposeful movement plays on various aspects of ToM in girls aged eight years was compared.

**Methods** In this quasi-experimental study with pre-test and post-test design, 40 girls with a mean age of 8.53 years from two elementary schools in Tehran were selected and randomly assigned to solitary play (n=13), group play (n=12), and control (n=15) groups after preliminary evaluations. The Test of Theory of Mind was completed immediately before and after an experimental period (eight weeks, 16 sessions of 60 minutes) and one month after the end of the intervention. The 3 (time)×3 (group) mixed analysis of variance and related post hoc tests at a 95% confidence level were used to analyze the data.

**Results** Recognition of emotions and pretense (PS<0.001), understanding of false belief (PS<0.001), and total level of ToM (PS<0.001) significantly improved in both experimental conditions, but second-order false belief and understanding of humor improved only in the group play condition (P<0.001). Furthermore, the scores of the recognition of emotions and pretense (PS<0.05), understanding of false belief (PS<0.05), second-order false belief and understanding of humor (PS<0.001), and the total level of ToM (PS<0.001) in the play condition group were significantly higher than solitary play in the post-test and follow-up.

**Conclusion** Although solitary movement plays improve the primary aspects of ToM, to facilitate the development of more advanced aspects, such as understanding of humor and second-order false belief, the use of group-based interactive-cooperative plays seems to be essential for eight-year-old girls.

**Keywords** False Belief, Pretense, Metaphor, Social Development, Movement Play.

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## Extended Abstract

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## Introduction

An extensive range of theories and empirical studies have examined the role of play in the development of various perceptual, cognitive, social, and motor aspects of children. One of the interesting areas is the role of physical and movement plays in the developmental process of children. Evidence shows that solitary movement plays are effective in improving the primary aspects of theory of mind (ToM). For example, Naderi et al. [28] reported that Dohsa-hou psycho-motor rehabilitation had positive effects on the primary aspects of ToM (recognition of emotions and pretense and understanding of false belief) in children aged 7-10 years, but no effect was found on the advanced aspects of ToM (understanding of second-order false belief). Similarly, Rafiee et al. [29] reported that training based on the perceptual-motor skills was effective in improving the primary aspects of ToM in children aged 8-12 years, but it had no effect on the advanced aspects. Therefore, it has been suggested that designing motor interventions based on the interpersonal interactions is necessary to influence the advanced aspects of ToM. To examine this hypothesis in the present study, the effect of solitary and group purposeful movement plays on the various aspects of ToM in girls aged eight years was compared.

## Materials and Methods

This research was a quasi-experimental study with a pre-test and post-test design. Based on the previous studies and using G\*Power software [37], the sample size was determined to be 42 individuals but to prevent a possible decline in the number of participants, the final sample size was considered to be 45 individuals ( $n = 15$  for each group). Participants were selected from two elementary schools in Tehran based on a research call and an invitation to parents. After obtaining parental consent and preliminary assessments, participants were randomly assigned to two experimental groups and one control group. Five participants were excluded from the study due to absence from training sessions or withdrawal from participation in the study. Finally, 40 participants in the solitary play ( $n=13$ ), group play ( $n=12$ ), and control ( $n=15$ ) groups completed the research process. The experimental intervention consisted of 16 sessions (two sessions of 60 minutes per week for eight weeks) performing two types of experimental protocols consisting of (1) solitary purposeful movement plays and (2) group purposeful movement plays. The Persian version of the Theory of Mind Test was used for the measurements [27]. The scores of

the test (zero (wrong answer) and one (correct answer)) is 0-20 in the first subscale (recognition of emotions and pretense, 20 items), 0-13 in the second subscale (understanding of false belief, 13 items), 0-5 in the third subscale (second-order false belief and understanding of humor, 5 items), and 0-38 in the total test. A higher score on the test indicates higher levels of ToM [27]. The levels of ToM were measured three times throughout the study: Immediately before (pre-test) and after (post-test) the intervention and also one month after the intervention (follow-up test). Considering the statistical assumptions, mixed analysis of variance with a 3 (pre-test/post-test/follow-up test) $\times$ 3 (solitary play/group play/control condition) design, paired-samples t test with the Bonferroni correction, one-way analysis of variance (ANOVA), and the Fisher's least significant difference (LSD) test were used to analyze the data at 95% confidence level.

## Results

Participants' age, height, weight, body mass index, and intelligence quotient were  $8.53\pm 0.29$  years,  $127.17\pm 2.35$  cm,  $25.72\pm 1.49$  kg,  $16.03\pm 3.14$  kg/m<sup>2</sup>, and  $102.11\pm 3.16$ , respectively and there was no significant difference among the three groups in terms of age ( $P=0.260$ ), height ( $P=0.805$ ), weight ( $P=0.581$ ), body mass index ( $P=0.919$ ), and intelligence quotient ( $P=0.111$ ). The mean and standard deviation of ToM aspects by group and measurements are shown in Table 1. The results of 3 $\times$ 3 ANOVA showed that the main effect of time ( $F_{(1.47, 54.57)}=36.79$ ,  $P<0.001$ ,  $\eta^2=0.499$ ) and the interaction effect of time and group ( $F_{(1.498, 54.57)}=8.21$ ,  $P<0.001$ ,  $\eta^2=0.307$ ) on the recognition of emotions and pretense were significant. Also, the main effect of time ( $F_{(1.498, 55.43)}=87.025$ ,  $P<0.001$ ,  $\eta^2=0.702$ ), the main effect of group ( $F_{(2, 37)}=4.67$ ,  $P=0.007$ ,  $\eta^2=0.229$ ), and the interaction effect of time and group ( $F_{(2.996, 55.43)}=10.583$ ,  $P<0.001$ ,  $\eta^2=0.364$ ) on the understanding of false belief were significant. Additionally, the main effect of time ( $F_{(2, 74)}=12.226$ ,  $P<0.001$ ,  $\eta^2=0.248$ ) and the interaction effect of time and group ( $F_{(2, 74)}=5.872$ ,  $P<0.001$ ,  $\eta^2=0.241$ ) on the second-order false belief and understanding of humor were significant. Similarly, the main effect of time ( $F_{(1.416, 52.398)}=99.487$ ,  $P<0.001$ ,  $\eta^2=0.729$ ) and the interaction effect of time and group ( $F_{(2.832, 52.398)}=14.768$ ,  $P<0.001$ ,  $\eta^2=0.444$ ) on the total level of ToM were significant. Based on the within-group comparisons (Table 1), the recognition of emotions and pretense ( $PS<0.001$ ), understanding of false belief ( $PS<0.001$ ), and total level of ToM ( $PS<0.001$ ) in both experimental conditions improved significantly, but the second-order false belief and understanding of humor improved only in the group play ( $P<0.001$ ). Based on the

**Table 1.** Descriptives of the theory of mind aspects by group and measurement and summary of within- and between-group post hoc comparisons

| Variable                             | Group    | Measurement |                           |                           | Within-Group Comparisons |           |                         |           |
|--------------------------------------|----------|-------------|---------------------------|---------------------------|--------------------------|-----------|-------------------------|-----------|
|                                      |          | Mean±SD     |                           |                           | Pre-Test and Post-Test   |           | Post-Test and Follow-up |           |
|                                      |          | Pre-Test    | Post-Test                 | Follow-up                 | t                        | Cohen's d | t                       | Cohen's d |
| Recognition of Emotions and Pretense | Solitary | 17.15±1.67  | 18.69±1.43 <sup>a,b</sup> | 18.31±1.37 <sup>a,b</sup> | -9.47***                 | 0.98      | 0.071                   | 0.01      |
|                                      | Group    | 18.01±1.75  | 19.16±1.41 <sup>b</sup>   | 18.91±1.31 <sup>b</sup>   | -8.09***                 | 0.72      | 0.993                   | 0.18      |
|                                      | Control  | 17.60±1.80  | 17.62±1.99                | 17.69±1.56                | -0.083                   | 0.01      | -0.125                  | 0.04      |
| Understanding of False Belief        | Solitary | 7.15±1.62   | 9.53±1.94 <sup>a,b</sup>  | 9.15±1.91 <sup>a,b</sup>  | -9.049***                | 1.32      | 0.481                   | 0.20      |
|                                      | Group    | 7.99±1.75   | 10.16±2.08 <sup>b</sup>   | 9.83±1.89 <sup>b</sup>    | -8.75***                 | 1.12      | 0.968                   | 0.17      |
|                                      | Control  | 7.53±1.64   | 7.75±1.51                 | 8.20±1.42                 | -0.749                   | 0.14      | -0.933                  | 0.17      |
| Second-Order False Belief            | Solitary | 1.37±0.96   | 1.53±0.77 <sup>a,b</sup>  | 1.61±0.76 <sup>a,b</sup>  | -1.01                    | 0.22      | -0.365                  | 0.13      |
|                                      | Group    | 1.33±0.89   | 2.50±1.16                 | 2.48±0.91                 | -8.92***                 | 1.41      | 0.128                   | 0.03      |
|                                      | Control  | 1.40±0.91   | 1.46±0.51                 | 1.47±0.73                 | -0.335                   | 0.09      | -0.087                  | 0.02      |
| Total Level of ToM                   | Solitary | 25.68±3.40  | 29.75±3.44 <sup>a,b</sup> | 29.07±3.25 <sup>a,b</sup> | -9.44***                 | 1.19      | 1.23                    | 0.20      |
|                                      | Group    | 27.33±3.95  | 31.82±3.21 <sup>b</sup>   | 31.22±3.78 <sup>b</sup>   | -9.71***                 | 1.23      | 1.19                    | 0.15      |
|                                      | Control  | 26.53±3.66  | 26.80±3.55                | 27.36±3.09                | -0.253                   | 0.07      | -1.35                   | 0.17      |

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(a) Significant difference compared to the group plays ( $P \leq 0.05$ ). (b) Significant difference compared to the control conditions ( $P \leq 0.05$ ). \* $P \leq 0.05$ , \*\* $P \leq 0.01$ , \*\*\* $P \leq 0.001$ .

between-group comparisons (Table 1), The mean scores of recognition of emotions and pretense ( $PS < 0.05$ ), understanding of false belief ( $PS < 0.05$ ), second-order false belief and understanding of humor ( $PS < 0.001$ ), and the total level of ToM ( $PS < 0.001$ ) in the group play condition were significantly higher than solitary play in the post-test and follow-up.

## Discussion

Solitary and group purposeful movement plays are both proper ways to improve the primary aspects of ToM in girls aged eight years, but creating interpersonal interactions in the form of group plays, facilitates the development of more advanced aspects of ToM, such as second-order false belief and understanding of humor. The results of the present study regarding solitary plays are consistent with the findings of previous studies on the effectiveness of motor interventions on the primary aspects of ToM [28, 29]. In order to create social interaction in the present study, associative and cooperative play was used, which seems to play a role in improving the second-order false

belief and understanding of humor. The role of social interactions in the development of ToM is supported by theories derived from Vygotsky's socio-cultural theory. According to these theories, children who have more experience in social interactions perform better in tasks that require an understanding of the mind (such as the task of false belief) [33]. Based on the research findings, it is suggested to use group movement plays with an emphasis on interpersonal interactions to facilitate the development of ToM among children in whom the developmental process of ToM has not been completed.

## Ethical Considerations

### Compliance with ethical guidelines

In the implementation of the research, ethical considerations were considered according to the instructions of the ethics committee of the Research Institute of Physical Education and Sports Sciences, and the code of ethics was received under the number IR.SSRI.REC.1399.887.

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### Authors' contributions

All authors contributed equally in preparing all parts of the research.

### Conflict of interest

The authors declared no conflict of interest.

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