Journal of Experimental Child Psychology 111 (2012) 319–330

Contents lists available at SciVerse ScienceDirect

Journal of Experimental Child Psychology

journal homepage: www.elsevier.com/locate/jecp

Perceiving children's behavior and reaching limits in a risk environment

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ARTICLE INFO

Article history:
Received 25 February 2011
Revised 20 September 2011
Available online 22 October 2011

Keywords:
Children
Parental supervision
Reaching
Perception
Affordances
Drowning

ABSTRACT

The purpose of this study was to investigate the accuracy of parents' perception of children's reaching limits in a risk scenario. A sample of 68 parents of 1- to 4-year-olds were asked to make a prior estimate of their children's behavior and action limits in a task that involved retrieving a toy out of the water. The action modes used for reaching, accuracy of estimates, and error tendency were investigated. Several morphological variables, walking experience, and swimming program experience were analyzed as predictors of maximum and estimated maximum reachability. Most children sat to retrieve the toy out of the water and fell in while attempting to grasp beyond their reaching limit. Nearly 80% of the parents correctly predicted their children's behavior when the toy was unreachable. Parents were cautious in predicting their children's maximum reachability (>50% underestimates). Mothers were more accurate than fathers in estimating their children's reaching limit. The prediction of children's capabilities was based partially on body dimensions and proportions.

Introduction

Parents' perception of their children's action limits and capabilities is of paramount importance in terms of child safety. As infants and children explore the world, they test their limits and try activities that are not always within their physical capabilities. Parents must be aware of their children's action capabilities to help their exploration in a challenging yet safe way.

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doi:10.1016/j.jecp.2011.09.005

The opportunities for action of an actor in an environment, or affordances, are specified by public information that is available not only to the actor but also to an observer (Gibson, 1979). Research has shown that adults are able to estimate other adults' affordances in several different tasks (e.g., Mark, 2007; Stoffregen, Gorday, Sheng, & Flynn, 1999). Adults perceive what actions are possible not only for themselves but also for other adults based on the relationship between relevant properties of the environment and what they estimate to be the actors' action capabilities. The issue of adults' estimations of children's affordances is of great relevance because it influences the way adults interact with children and the way they arrange children's environments. The studies that have addressed this issue so far have focused on two different areas: (a) the perception of infants' crawling ability on different slopes (Ishak, Tamis-LeMonda, & Adolph, 2007; Mondschein, Adolph, & Tamis-LeMonda, 2000) and (b) the perception of children's vertical reaching capability (Cordovil & Barreiros, 2010a, 2010b, 2011). The former group of studies indicates that there exists a gender bias in mothers' expectations of their infants' crawling ability and crawling attempts (underestimating girls' performance) and that fathers have a greater tendency than mothers to emphasize challenge. The latter group of studies indicates that parents tend to overestimate their children's vertical reachability, that experienced observers are more accurate than inexperienced observers, and that young children's reachability is more difficult to estimate than older children's reachability. The current study aimed to analyze parents' perception of children's horizontal reachability in a risk scenario.

Reaching is an action that emerges quite early in development. Infants already make reaching attempts at 15 weeks of age, but these reaches do not lead to successful grasping (von Hofsten & Lindhagen, 1979). At around 18 weeks of age, infants begin catching stationary and moving objects successfully (von Hofsten, 1980, 1983; von Hofsten & Lindhagen, 1979; von Hofsten, Vishton, Spelke, Feng, & Rosander, 1998), and by 9 months of age, infants adjust their hand aperture relative to the size of the target object (von Hofsten & Rönnqvist, 1988). At the onset of walking, the possibilities for exploration increase dramatically, hands can operate with greater autonomy, and objects that were previously unreachable become accessible. Curiosity leads children's exploration, and reaching objects in high places becomes a challenge that increases the potential for accidents. Horizontal reaching, on the other hand, is an action that usually is not related to accidents except in some specific environments such as swimming pools. In fact, children's increasing mobility and reaching capabilities might lead them to enter a pool area and lean over the pool to try to reach floats, balls, or other toys that are in the water. This behavior has been referred as a drowning risk factor (Centers for Disease Control and Prevention [CDC], 2004).

Drowning is the second leading cause of child unintentional injury death worldwide (Peden et al., 2008), with the highest rates among boys under 5 years of age (Peden & McGee, 2003; Peden et al., 2008; Vincenten, 2004). In the United States, drowning is the leading cause of unintentional injury death among 1- to 4-year-olds (Borse et al., 2009). Children in this age group in high-income countries are most likely to drown in swimming pools (Brenner et al., 2003; Quan, Gore, Wentz, Allen, & Novack, 1989). Lack of safety barriers and inadequate supervision are major risk factors in children's drowning (Blum & Shield, 2000; Cordovil, Barreiros, Vieira, & Neto, 2009; Cordovil, Vieira, & Barreiros, 2011).

The study of children's behavior and exploratory movements around a swimming pool is of great relevance in terms of child safety. Exploratory movements are self-initiated and can be simple spontaneous actions that generate information about the position of the body relative to gravity and the supporting surface or movements produced with the express purpose of gathering additional information about possibilities for action (Adolph, Eppler, Marin, Weise, & Wechsler Clearfield, 2000).

The literature that analyzes risk-taking behaviors at swimming pools is scarce. In the current study, we intended to fill this gap by analyzing the parents' perception of their children's actions in a specific risk-taking behavior (i.e., trying to reach a toy in a swimming pool).

The current study aimed to analyze parents' perception of their children's affordances in a specific risk scenario (i.e., a swimming pool) that is common to most children and that is likely to involve parental supervision. We analyzed this reachability task according to four more specific goals. First, we sought to categorize children's actions to catch a toy in the water from the swimming pool border. Those actions involved the action modes used to reach the toy and exploratory movements. Second, we sought to quantify the number of children who would jump or fall in the water to reach the toy beyond their reaching limits and to compare the children's behavior with their parents' expectations.

Third, we intended to investigate the accuracy of parents' estimates. Finally, we intended to investigate potential predictors of children's maximum reachability and of parents' estimates of children's maximum reachability (i.e., morphologic variables, walking experience, or swimming program experience). The influence of children's and parents' gender and age in this task was also investigated because previous studies have reported (a) an influence of children's gender (Mondschein et al., 2000) and age (Cordovil & Barreiros, 2010a) in adults' estimates, (b) differential behavior of fathers and mothers toward their children in potentially risky situations (Ishak et al., 2007), and (c) an effect of observers' experience in the estimates of children's action capabilities (Cordovil & Barreiros, 2010b).

Method

Participants

A convenience sample of 68 parents (35 men and 33 women, mean age = 35.3 years, *SD* = 3.6, range = 27.3–42.7) and their children (*N* = 68, 38 boys and 30 girls, mean age = 2.5 years, *SD* = 0.9, range = 1.10–3.94) participated in the study. For some analyses, the children were divided in two groups: the younger children, who were under 2 years of age (*n* = 24, mean age = 1.6 years, *SD* = 0.3), and the older children, who were 2 years of age and over (*n* = 44, mean age = 3.0 years, *SD* = 0.6). The adults were also divided into two groups: the younger parents, who were under 33 years of age when their children were born (*n* = 34, mean age = 36.2 years, *SD* = 2.5), and the older parents, who were 33 years of age and over when their children were born (*n* = 34, mean age = 42.7 years, *SD* = 2.3). There were 21 father/boy pairs, 17 mother/boy pairs, 16 mother/girl pairs, and 14 father/girl pairs in our sample. Participants were recruited from a family health club (in the Lisbon area of Portugal) that offers aquatic programs for children starting from 3 months of age. Descriptive data of the children is presented in Table 1.

Apparatus

A rubber duck was attached to a plastic structure that allowed the experimenter to move it away from or closer to the swimming pool deck in 5-cm intervals (see Fig. 1).

Procedures

Prior to the experimental situation, approval from the ethics committee of the faculty and informed consent from the parents of the children were obtained.

Previous procedures

After entering the swimming pool area, each parent filled in a questionnaire with descriptive data (e.g., birth dates of parent and child, child's age at walking onset), and the child's anthropometric mea-

Table 1
Descriptive data of the children (*N* = 68).

Variable	Minimum	Maximum	*M*	*SD*
Age (years)	1.1	3.9	2.5	0.9
Age at walking onset (years)	0.8	1.3	1.0	0.1
Walking experience (years)	0.0	3.0	1.5	0.9
Age at swimming program onset (years)	0.2	3.9	1.2	1.0
Swimming program experience (years)	0.0	3.4	1.3	1.0
Height (cm)	72.5	108.0	89.3	8.0
Arm span (cm)	72.0	103.0	87.3	7.9
Sitting height (cm)	45.5	60.0	51.5	3.2
Weight (kg)	10.0	24.0	14.0	2.4
Maximum reachability (cm)	15.0	55.0	35.1	8.08

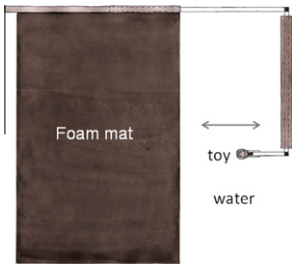

Fig. 1. Top view of the apparatus. A rubber duck attached to a plastic structure could be moved away from or closer to the swimming pool deck, just above the water level.

sures were taken. The child was barefoot and in a swimming suit during the measurements and the experimental procedure. To measure stature, the child was asked to stand against the wall facing directly ahead (i.e., head aligned in the Frankfort plane), with heels together and arms by the sides, and the distance from the floor to the vertex of the head was marked. To measure sitting height, the child sat in an aerobic step, with the lower back and shoulders against the wall and looking straight ahead, and the distance of the vertex of the head to the base of the sitting surface was measured. Instead of using a stadiometer for measuring stature and sitting height, marks were made with an erasable pen in the swimming pool wall tiles and the distance was measured afterward. To measure arm span, the child stood with his or her back to the wall, feet together, with the arms as horizontal as possible with palms facing forward and fingers fully extended, and the distance from tip to tip of the third finger was marked on the wall. Two investigators were necessary to collect this measurement because children had difficulty in maintaining their arms outstretched. To measure weight, the child was put on the center of a weighing scale with his or her weight distributed on both feet and looking straight ahead with arms by the sides.

Walking experience in years ([observation date – walking onset date]/365.25) was calculated based on data provided by the parent, and swimming experience in years ([observation date – swimming program onset date]/365.25) was calculated based on the health club records.

Parents' estimates

After the child's anthropometric data were collected, the parent was asked to stand one step away from the pool border, facing the rubber duck, and to make judgments concerning the maximum horizontal reachability of the child. Maximum horizontal reachability was defined as the greatest distance at which the child could take the toy out of the water without jumping or falling into the swimming pool. The duck was initially positioned at the approximate distance of the child's arm, and the parent would ask the experimenter to move it away from or closer to the pool border until he or she believed that it was at the child's maximum reachability. Each parent estimated his or her child's reachability only once. The parents were told that the children would be placed standing on the border of the pool but that the child would be allowed to choose his or her preferred position to try to get the toy out of the water. The parent was also told that an experimenter would be in the water to assist the child if necessary. The parent was then asked what the expected behavior of the child would be when he or she could not reach the toy from the pool border (stay on the pool border or end up in the swimming pool by either falling or jumping).

Children's reachability

After the parent's estimate was registered, the child was placed standing on the swimming pool border in front of the toy and was asked to retrieve the toy from the water without going into the pool. In line with the method of previous studies (Adolph, 1995, 1997), each trial was coded on-line as a success (grasped the toy), a failure (tried to reach the toy but fell or jumped in the water), or a refusal (did not try to reach the toy). Failures and refusals were treated as equivalent for the purpose of identifying the child's reaching boundary. The toy was initially placed at the maximum horizontal reach-

ability distance predicted by the parent and would be moved away from the pool border following a successful grasp or closer to the pool border following a failure. If the child succeeded in the first attempt, the process of moving the toy away continued until the first failure. If the child failed or refused to reach in the first attempt, the process of bringing the toy closer to the pool border continued until the first successful grasp. The number of trials that each child performed was not fixed because it was related to the amount of error of the parent's estimate. For example, if a parent had predicted that the child would grasp the toy 30 cm away from the pool border and the child's reaching limit was 35 cm, that means that the child performed three trials (i.e., success at 30 cm, success at 35 cm, and failure or refusal at 40 cm). We did not converge on a reaching boundary to a 67% criterion (i.e., determining the greatest distance at which the child would grasp the toy on at least two of three trials and failed or refused on at least two of three trials in the next increments) as done in previous studies to find children's crawling boundaries (Adolph, 1995; Mondschein et al., 2000) because that option would have greatly increased the number of times that children could fall in the water and it could have been difficult to keep the children motivated under those circumstances. For safety reasons, the child was placed over a foam mat at the border of the swimming pool. All trials were recorded (25 Hz) using a video camera placed 2.30 m above the water level in a lateral position.

Data collection and analysis

The videotaped action modes of all children were analyzed separately by two motor development experts. Only one action mode was coded for each child (i.e., the action mode used in the child's maximum reachability distance). An interobserver reliability analysis using the kappa statistic was performed to determine consistency among raters. The interobserver reliability was kappa = .96 ($p < .001$), 95% confidence interval (CI) (0.893, 1.035).

Accuracy of predicted behavior was obtained by comparing each parent's expected behavior for the child beyond maximum reachability distance (stay on the pool border or end up in the swimming pool by either falling or jumping) with the actual behavior of the child. Two categories of accurate predictions and two categories of discrepant predictions were possible, namely that (a) the parent predicted that the child would fall in the water and the child fell in the water, (b) the parent predicted that the child would stay on the deck and the child stayed on the deck, (c) the parent predicted that the child would fall in the water and the child stayed on the deck, and (d) the parent predicted that the child would stay on deck and the child fell in the water.

The group's constant error (CE) (Σ[estimate – actual measure]/N) was analyzed to perceive parents' overall accuracy in this task. However, constant error is a signed error where positive values (overestimates) and negative values (underestimates) average out; therefore, underestimates compensate overestimates when considering the mean group's value. For this reason, the accuracy of reaching estimates was evaluated by absolute error (AE) and absolute percentage error (APE). AE |(estimate – actual measure)| considers the deviation without considering the direction of the error. This variable eliminates the possibility of cancellation of error depending on the direction, but its value is independent of the capabilities of the actor (e.g., a difference between the estimate and the reachability of 5 cm corresponds to an AE of 5 cm whether the child's reaching limit is 10 or 50 cm). APE (|1 – estimate/real reachability| $\times$ 100) (cf. Cordovil & Barreiros, 2010a, 2011) indicates the amount of error in percentage of the real reachability of the child and is a good indicator of the perceiver's accuracy because it is expressed in absolute value and it is scaled to the actor (e.g., a 5-cm difference in 10 cm corresponds to an APE of 50% and a 5-cm difference in 50 cm corresponds to an APE of 10%). Because AE and APE are expressed in absolute values, error direction was analyzed by error tendency (i.e., the amount of underestimates, accurate estimates, or overestimates). Error tendency was coded as follows: underestimate if the parent's estimate was less than the child's real reachability, accurate estimate if the values were the same, and overestimate if the parent's estimate was greater than the child's real reachability.

For the statistical analysis, univariate analyses of variance (ANOVAs) were used to determine the effects of gender and age on the performance of the children and on the estimates. Frequency distributions and chi-square (χ^2) tests were adopted to analyze error tendency, accuracy of predicted

behavior, and action modes used for reaching the toy. A stepwise linear regression analysis was used to investigate predictors for maximum reachability and estimated maximum reachability.

Results

Action modes and exploratory behaviors for retrieving the toy

Four action modes for retrieving the toy out of the water were identified based on the child's position on the deck: sitting, squatting, crawling, and ventral support (see Fig. 2).

Most children (80.9%) chose the sitting posture to retrieve the toy out of the water. The other three action modes were used with less frequency, namely squatting (8.8%), crawling (5.9%), and ventral support (4.4%). A small group of children (13.2%) switched between strategies to reach the toy in the different attempts. The preference for the sitting action mode was stronger in the younger children (91.7% chose this action mode vs. 75% of the older children), but the differences were not significant between the age groups, $\chi^2(3) = 3.63$, $p = .304$. Boys tried a greater variety of action modes to reach the toy than girls (96.7% of the girls vs. 68.4% of the boys chose sitting), $\chi^2(3) = 9.01$, $p = .029$. In what concerns exploration, the majority of the children (82.4%) tried to reach the toy directly, using only inattentiveness and spontaneous slight movements to gather information about their body position and to help them perceive the limits of maintaining their balance in their chosen posture. A few children used explicit exploratory behaviors; some tried to reach the toy with their feet (13.2%), some agitated the water with their hands in trying to bring the toy closer to the pool border (2.9%), and one child used both exploration techniques (1.5%). There were no differences in the exploration strategies used by younger and older children, $\chi^2(3) = 1.11$, $p = .775$, or by boys and girls, $\chi^2(3) = 1.36$, $p = .714$.

Behavior beyond reaching limit

When the toy was unreachable, 69.1% of the children fell or jumped in the water to grasp it. Most parents (77.9%) accurately predicted their children's behavior in this situation (see Fig. 3).

Children's behavior beyond the reaching limit was not dependent on children's age, $\chi^2(1) = 2.02$, $p = .155$, or gender, $\chi^2(1) = 0.84$, $p = .359$. Parents' accuracy of predicted behavior (i.e., knowing whether their children would fall or stay on the deck beyond the reaching limit) did not depend on children's gender, $\chi^2(3) = 1.40$, $p = .706$, or on parents' gender, $\chi^2(3) = 6.18$, $p = .103$, or age group, $\chi^2(3) = 2.76$, $p = .430$. There were more discrepant predictions for younger children (29.2%) than for older children (18.1%), but the difference was not significant, $\chi^2(3) = 7.13$, $p = .068$.

Children's reaching limits and parents' estimates

In total, children in this study performed 221 trials (140 successful grasps, 54 failures, and 27 refusals). The numbers of trials, successes, failures, and refusals per child are presented in Table 2.

Children's reaching limits varied between 15 and 55 cm ($M = 35.1$ cm, $SD = 8.1$). There was a significant main effect of age in children's reaching limit, $F(1,64) = 41.87$, $p < .001$, $\eta_p^2 = .395$ (see Table 3). The effect of children's gender and the interaction between children's age and gender were not significant.

Parents' estimates also ranged from 15 to 55 cm ($M = 31.8$ cm, $SD = 9.1$). There were significant main effects of children's age, $F(1,64) = 11.39$, $p = .001$, $\eta_p^2 = .151$, and gender, $F(1,64) = 4.40$,

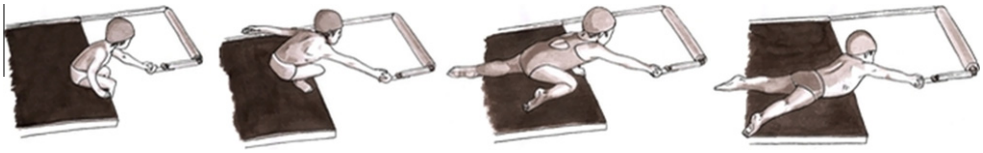

Fig. 2. Action modes used by children to grasp the toy. From left to right: sitting, squatting, crawling, and ventral support.

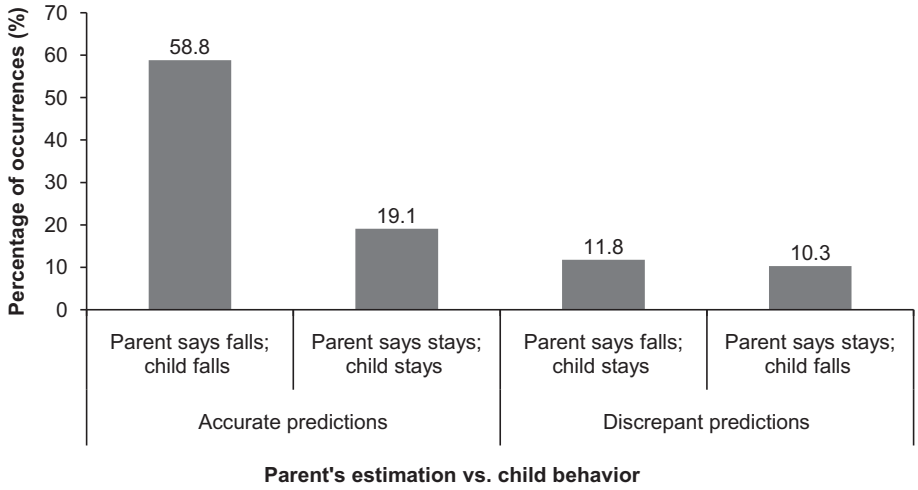

Fig. 3. Accuracy of predicted behavior beyond children's maximum reachability.

Table 2
Descriptive data of number of trials, successes, failures, and refusals per child.

Variable	Minimum	Maximum	*M*	*SD*
Trials per child	2	7	3.3	1.3
Successes per child	1	6	2.1	1.3
Failures per child	0	4	0.8	0.7
Refusals per child	0	3	0.4	0.6

$p = .040$, $\eta_p^2 = .064$, in parents' estimates. Estimates were significantly smaller for younger children than for older children and were also smaller for girls than for boys (see Table 3). The interaction between children's gender and age did not significantly influence parents' estimates. These estimates were also not influenced by the age or gender of parents or by the interaction between these variables.

Parents' estimation errors in the swimming pool task are presented in Fig. 4.

The constant error in this task was −3.24 cm ($SD = 9.33$) and was not dependent on children's or parents' gender or age group.

The AE varied between 0 and 25 cm ($M = 7.5$ cm, $SD = 6.4$), and fathers' AE ($M = 9.3$ cm, $SD = 6.8$) was greater than mothers' AE ($M = 5.6$ cm, $SD = 5.4$), $F(1,64) = 6.65$, $p = .012$, $\eta_p^2 = .094$. Parents' age group and children's gender and age group did not influence the AE values.

The APE varied between 0% and 80% ($M = 21.6\%$, $SD = 18.0$) and was lower in mothers ($M = 17.0\%$, $SD = 16.1$) than in fathers ($M = 25.9\%$, $SD = 18.8$), $F(1,64) = 4.52$, $p = .037$, $\eta_p^2 = .066$. Parents' age group and children's gender and age group were not related to the APE values.

Parents generally underestimated their children's reachability (52.9% underestimates, 23.5% accurate estimates, and 23.5% overestimates). Error tendency was not related to children's gender, $\chi^2(2) = 2.45$, $p = .293$, and children's age group, $\chi^2(2) = 0.89$, $p = .641$, or to parents' age group, $\chi^2(2) = 0.36$, $p = .835$. However, it differed slightly between fathers and mothers, $\chi^2(2) = 5.97$, $p = .050$. Mothers had a greater number of accurate estimates (36.4%) than fathers (11.4%) (see Fig. 4).

Predictors of children's reachability and of parents' estimates

A linear stepwise analysis in which children's age, the anthropometric variables, walking experience, and a swimming program experience were entered as independent variables indicated as predictors of maximum reachability height and sitting height ($R^2 = .559$, $F = 41.18$, $p < .001$). All of the other

Table 3
Means and standard deviations of children's reaching limit and of parents' estimates according to children's gender and age groups.

Group	Reaching limit		Parents estimates	
	M	*SD*	*M*	*SD*
Younger children	28.1	6.1	26.7	8.3
Older children	38.9	6.4	34.7	8.2
Boys	36.3	8.4	34.6	8.9
Girls	33.5	7.5	28.3	8.0

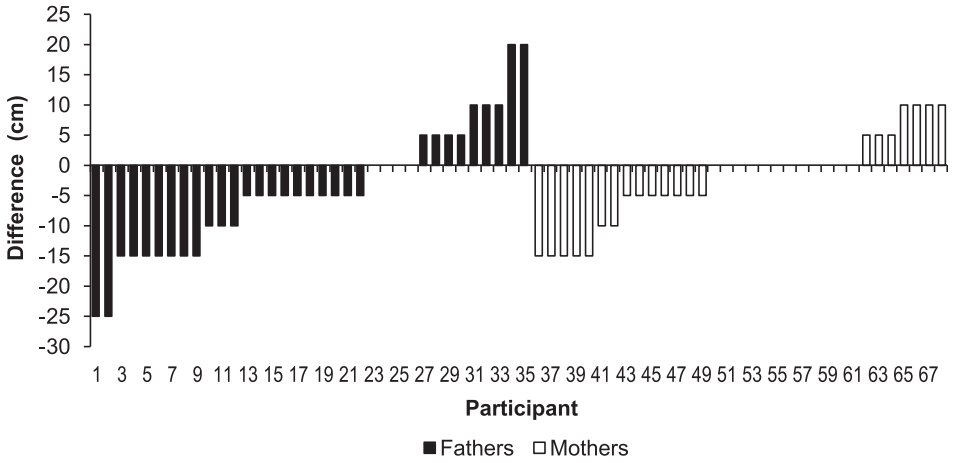

Fig. 4. Accuracy of each father's and mother's estimate of his or her child's reaching limit in the swimming pool task. Individual parents are represented along the *x* axis. Values of bars <0 indicate underestimates; values of bars = 0 (not visible) indicate accurate estimates; values of bars >0 indicate overestimates.

variables were excluded from the model (all *ps* > .60). For the prediction of estimated maximum reachability, the same variables and the age of the observer were entered. Sitting height was the best predictor of estimated maximum reachability (R^2 = .240, F = 20.89, p < .001). All of the other variables were excluded from the model (all *ps* > .20).

Discussion

In this study, we aimed to analyze parents' perception of children's affordances in a risk scenario. We characterized children's action modes and behavior in the task of retrieving a toy from a swimming pool and investigated the accuracy of parents' estimates. The influence of different variables, such as gender, sex, morphology, and experience, in children's reaching limit and in parents' estimations was also examined.

The results of our study indicate that most parents were generally cautious in predicting their children's maximum reachability in this swimming pool task. Approximately 53% underestimated their children's reachability, contradicting the overestimation tendency verified by previous studies in horizontal reaching tasks (Fischer, 2003) and vertical reaching tasks (Cordovil & Barreiros, 2010b) when a *first-person* perspective (i.e., observer behind the model) is adopted. Some previous studies (Fischer, 2003; Rochat, 1995) identified an underestimation tendency while judging other people's horizontal reachability when a *third-person* perspective (i.e., observer with a frontal view of the model) is adopted. Because that was not the case in the current study, we suspect that the underestimation bias might be a result of a protective tendency of parents that is more evident in a risk environment. In fact, the percentage of underestimates in this task is really close to the percentage of underestimates in a

previous study that addressed mothers' predictions of their children's behavior under risk (i.e., crawling steep slopes) (Mondschein et al., 2000). Mondschein and colleagues (2000) concluded that 12 of the 23 mothers (52%) underestimated their children's crawling ability. However, those values were greater in mothers of girls (75% underestimated their daughters' ability) than in mothers of boys (only 27% underestimated their sons' ability). This was not the case in the current study, which found no differences in error tendency according to children's gender. Our study partially supports Mondschein and colleagues' findings because in both studies there were no significant differences in girls' and boys' performance but parents' estimates were smaller for girls than for boys, indicating the existence of a greater underestimation tendency for girls than for boys. The difference in parents' estimates, although significant, was not enough to influence the error magnitude given that we found no differences in AE or APE for girls and boys. Children's gender did not influence error magnitude or error tendency, indicating that the differential treatment for boys and girls reported by previous studies (Mondschein et al., 2000; Morrongiello & Dawber, 1998, 2000) did not result in differences in estimate accuracy in this study.

Some parents (23.5%) accurately predicted their children's maximum reachability. However, there were also parents who had quite large values of AE and APE, indicating a lack of knowledge about their children's real action capabilities in this situation. Parents' perception of the risk inherent to this task seems to have influenced the way they perceived their children's affordances. Studies that addressed the estimate of vertical distances suggest that fear and emotional arousal influence one's perception of distance (Stefanucci & Proffitt, 2009; Stefanucci & Storbeck, 2009).

Mothers were more accurate than fathers in predicting their children's maximum reachability (i.e., they had lower values of APE and had a greater frequency of accurate estimates). Previous studies (Ishak et al., 2007) indicate that mothers are more likely to display parenting choices that are more safety oriented than fathers. In our study, we did not ask parents what would be the maximum distance they would allow their children to reach the toy in this task, which might have been different from their estimate of their children's maximum reachability, so it is difficult to compare the parenting choices they adopted (i.e., emphasizing safety or challenge). Still, we observed that fathers were responsible for greater errors in underestimates and overestimates. In Ishak and colleagues' (2007) study, parents' estimates were not compared with children's real ability, so it is not possible to determine who was more accurate, the mothers or the fathers. We can speculate that mothers' greater tendency to emphasize safety, allied to greater involvement with their children in younger ages, might have led to a distinction in the way both genders estimated children's reachability. On the contrary, a male advantage has been reported in different estimation tasks such as easy coincidence anticipation timing tasks (Sanders, 2011) and mental rotation tasks (Alexander & Evardone, 2008). In the latter, the men's advantage seems to be reduced if the stimuli are human figures and not the standard block figures (Alexander & Evardone, 2008), indicating a greater female capability to estimate human figures that might positively influence their estimation of human actions.

Parents' and children's age groups were not related to the accuracy of parents' estimates or error tendency. These findings seem to contradict previous studies indicating that experienced observers are more accurate and that younger children's affordances are more difficult to estimate (Cordovil & Barreiros, 2010b, 2011). However, these contradictions should be interpreted with caution. First, the fact that one group of parents was older than the other group when their children were born does not mean that they were more experienced in perceiving children's affordances. In this case, experience and age might not be correlated. Second, the nature of this task is quite different from that of the vertical reachability tasks in which children's performance is clearly constrained by their anthropometric characteristics (i.e., body scaled). The influence of children's age on the accuracy of perceivers' estimates in different tasks might be further explored in future studies.

Children's predominant behavior beyond their reaching limit was falling or jumping in the water (69.1%). That was not surprising for most parents, and nearly 80% of them accurately predicted what their children's behavior would be when the toy was no longer reachable. The accuracy of predicted behavior was not influenced by parents' or children's gender or age group, although the younger children's behavior tended to be more difficult to predict ($p = .068$). The major concern in terms of child safety is the discrepant judgment of 10.3% of parents who wrongly believed that their children would stay on the deck when they could not reach the toy. Even though children were encouraged to retrieve

the toy out of the water, and the environmental conditions were favorable for getting in the water (i.e., children in a bathing suit, warm water, investigator in the water), nearly one-third stayed on the deck if the toy was beyond their maximum reachability. We believe that this proportion might be different (probably higher) in a different scenario (e.g., child dressed, cold water, no one around).

The environmental conditions might also have influenced the action mode chosen by the children to retrieve the toy out of the water. Most children (80.9%) sat on the border of the pool to retrieve the toy. Children's age group was not related to the action modes or exploration modes used by the children in this task. Sitting seems to be the most comfortable action mode for this kind of task in children of this age. Most children sat with their feet in the water, but this could be different if they had had shoes on, and probably some children would have tried different action modes. This is an interesting issue to address in future studies.

Boys tried a greater variety of action modes to reach the toy than girls, suggesting that boys were more inventive than girls in this task. The greater tendency for boys to explore different motor solutions and to be more motorically active than girls might also be one of the factors contributing to their greater injury rates (Eaton & Yu, 1989; Peden et al., 2008). The fact that girls seem to be less inventive in motor tasks might also explain the smaller parental estimates verified for girls in the current study.

Anthropometric characteristics, namely height and sitting height, explained approximately 56% of the variability of maximum reachability. The small value of the coefficient of determination indicates that although reachability seems to be clearly constrained by one's body dimension (Carello, Grosofsky, Reichel, Solomon, & Turvey, 1989), it is also influenced by other factors in this specific task. Body dimensions have proven to be successful at identifying action limits in adults but not in very young children (Ulrich, Thelen, & Niles, 1990). Instead, experience (Adolph, 1997, 2000; Kingsnorth & Schmuckler, 2000; Zwart, Ledebt, Fong, de Vries, & Savelsbergh, 2005) seems to influence children's actions at younger ages. However, walking experience and swimming program experience did not significantly influence children's reaching limits in the task of retrieving a toy from the swimming pool. Parents' predictions of maximum reachability were also based on children's morphology, namely on sitting height, but only approximately 24% of the variability of predicted maximum reachability was explained by this variable. This indicates that, in this situation, parents probably rely on other variables to estimate their children's maximum reachability. Variables such as specific temperamental characteristics of the children (Schwebel & Barton, 2005) or even of the parents might influence parents' judgments of children's capabilities.

This study provides empirical evidence for the CDC (2004) recommendation that the presence of toys in the swimming pool may encourage children to enter the pool area or lean over the pool and potentially fall in the water. When safety barriers and supervision fail, the presence of toys in the water seems to be a risk factor for drowning. The conclusions of this study indicate the importance of adult supervision around water environments and underline the need to remove toys from the pool and surrounding area immediately after use. Because parental supervision is a key variable in drowning prevention, it is also important to remove obstacles that may limit visual information of the deck areas. The fact that parents' underestimate their children's reachability in this type of task is in accordance with previous findings in other risk tasks (Mondschein et al., 2000) and might constitute a protective mechanism of error detection.

Mothers and fathers have a critical role in promoting their children's development by organizing the environment and their daily routines in ways that ensure safety but provide challenge. This task is easier if parents have an accurate perception of their children's action capabilities, which might be particularly difficult in risk situations. In this study, mothers estimated their children's reaching limit with greater accuracy than fathers. We believe that mothers' greater involvement with their children at younger ages might be part of the explanation for this difference, but this question remains to be further explored.

Acknowledgments

This research was supported by the Foundation for Science and Technology, Portugal (Grant SFRH/BD/39261/2007 awarded to R. Cordovil). We thank Eduarda Veloso, Ana Mateus, and Dora Ralão for

assistance with data collection. We also thank the Solplay Family Health Club and all of the participants.

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