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Knowledge and Misconceptions About the Causes of Disabilities and Functioning in Children and Preadolescents: Mixed-Models Analyses

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ABSTRACT

Background: Accurate knowledge of disabilities is connected to social acceptance and a high chance of initiating and facilitating meaningful social interactions with students with disabilities. The present study investigated the effect of type of disability and school grade level on knowledge of the causes of four disabilities (i.e., hearing, visual, motor and intellectual), misconceptions about the causes of these disabilities and knowledge of the functioning of peers with disabilities.

Methods: A sample of 868 Italian students ($M_{age} = 9.92$, $SD = 2.33$; school grade levels 1–8; 436 boys and 432 girls) was interviewed about their knowledge of causes of four disabilities, potential misconceptions and the knowledge of functioning of peers with disabilities. Mixed-effects models were applied with the GAMLj module of the JAMOVI statistical platform. The effects of type of disability and school grade level and their interaction were estimated as fixed effects, and gender was introduced as a control variable.

Results: Mixed-model analyses found a main effect of type of disability for knowledge and misconceptions about the causes of disabilities and knowledge of the functioning of peers with disabilities. A main effect for school grade level was also found, showing a progressive growth trend in knowledge of the causes of disabilities and of the functioning of peers with disabilities and a decrease in misconceptions with the increase in school grade levels. Lastly, a significant interaction effect of Type of Disability × School Grade Level was found for knowledge and misconceptions about the causes of disabilities, suggesting that the effect of school grade level varied across the type of disability.

Conclusion: Overall, the study found that children and preadolescents have a rudimentary and limited understanding of disabilities, suggesting the necessity for a specific formal education about disabilities during the school years for children and preadolescents.

1 | Introduction

Children with disabilities may be unaccepted by typically developing children, experiencing discrimination, social exclusion and isolation (Chae, Park, and Shin 2019). One of the factors that help to explain typically developing children's actions and attitudes toward peers with disabilities is their knowledge of various disabilities (Magiati, Dockrell, and Logotheti 2002). Accurate knowledge of disabilities is connected to social acceptance and a high chance of initiating

Summary

- Knowledge of the causes of disabilities and the functioning of peers with disabilities increased as the school grade level increases.
- Misconceptions about the causes of disabilities decreased as the school grade level increases.
- Children and preadolescents have a rudimentary and limited understanding of disabilities.
- Interventions are needed to promote knowledge of disabilities during the school years for children and preadolescents.

and facilitating meaningful integration activities with children with disabilities (Demetriou 2022; McManus et al. 2010), while the presence of misconceptions about disabilities may lead children to perceive the same people as potential threats, triggering a self-protective defence reaction manifested in stigmatization and discrimination (Babik and Gardner 2021). Examining typically developing children's knowledge of the causes of disabilities, potential misconceptions and knowledge of the functioning of peers with disabilities is particularly important for designing timely, age-appropriate and effective interventions to foster positive social interactions and thus promote school inclusion (Babik and Gardner 2021; McManus et al. 2010). Despite efforts for inclusive education, especially in Italy, where law 118/1971 granted children with disabilities the right to get access to mainstream schools and share classrooms with typically developing students (Ianes, Demo, and Dell'Anna 2020), misconceptions about and low knowledge of disabilities persist (Ekom-Idorenyin Wazor 2023).

Current research on this issue highlights the importance of age in children's understanding of disabilities. With age, typically developing children's knowledge of disabilities and of the functioning of peers with disabilities can increase (Babik and Gardner 2021). Studies in this field have mainly focused on the analysis of typically developing children's knowledge of disabilities, including comparisons between different age groups (e.g., Diamond 2001; Magiati, Dockrell, and Logotheti 2002). Studies have rarely analysed age-related changes between children in primary and lower secondary schools, and little attention has been paid to misconceptions and the functioning of children with disabilities. The present study addressed these gaps by considering knowledge of the causes of different disabilities, potential misconceptions and knowledge of the functioning of children with disabilities in a large sample of typically developing children.

2 | Knowledge of the Causes of Disabilities

As recently suggested by Babik and Gardner (2021), how typically developing children relate to peers with disabilities depends on their knowledge of disabilities and their general cognitive development. Babik and Gardner (2021) suggested that children 2- to 7-year-olds tend to examine and understand only the highly noticeable features of individuals with disabilities, such as adaptive equipment, while disregarding less noticeable features related, for example, to intellectual disability (ID) or autism (Babik and Gardner 2021). At 7- to 11-year-olds, typically developing children acquire better knowledge of disabilities, and this allows them to overcome a tendency to generalize deficits across different domains (e.g., assume that a child in a wheelchair would also be less cognitively competent) (Babik and Gardner 2021). From the 12th year, knowledge of disabilities becomes more articulated, including a greater understanding of less obvious disabilities such as ID.

Since the 1980s, various empirical evidence confirmed that knowledge of disabilities increases with age, starting with the awareness of motor disability (MD) and sensory disabilities (visual VD and hearing HD) during the years of kindergarten (Abrams, Jackson, and St. Claire 1990; Magiati, Dockrell, and Logotheti 2002). Beyond general cognitive development, additional variables affect typically developing children's knowledge of disabilities, such as society, family and school environment (Babik and Gardner 2021). Regarding the school context, typically developing children's knowledge of disabilities can be influenced both implicitly by direct exposure and experience with peers with disabilities and explicitly by educational experiences and teaching practices (Magiati, Dockrell, and Logotheti 2002). School education plays a significant role in influencing not only how children acquire knowledge but also how they come to represent knowledge in memory (Denervaud et al. 2021).

3 | Misconceptions About Disabilities

Many studies examining knowledge of various disabilities used true/false or false/incorrect options to evaluate knowledge. Thus, an incorrect answer on a true/false item could represent a strongly retained misperception, a feeble conviction or even the result of a guessing process. Hence, this method is not suitable for the direct identification of misconceptions and gathers little data regarding the firmness of people's confidence in the correctness of their knowledge (Sciutto 2015). We aimed to specifically examine any misconceptions children have about the causes of disabilities, intended as views or opinions that are not correct, based on incorrect thinking or understanding about disabilities (Sciutto 2015).

Even if previous studies have found a certain degree of knowledge of disabilities, overall, typically developing children's understanding of disabilities seems to be limited and rudimentary. There is a gap in children's knowledge, which may lead to misconceptions, limiting their availability to interact with peers with disabilities (Demetriou 2022). Magiati, Dockrell, and Logotheti (2002), involving 9- to 11-year-old children, found common stereotypic misconceptions of disabilities, gaps and over-simplistic generalizations, particularly in less evident disabilities (e.g., ID). Ralli et al. (2011), involving children aged 9–12 years, found that their knowledge of the causes of learning difficulties was very limited, with approximately 29% of children that thought that the cause of learning difficulties was a lack of motivation and effort, while 25% linked it to social or emotional problems.

4 | Knowledge of the Functioning of Children With Disabilities

No studies have examined children's knowledge of the functioning of peers with disabilities, following the biopsychosocial

model of functioning and disability embodied in the International Classification of Functioning, Disability, and Health (ICF; World Health Organization [WHO] 2001). The ICF conceptualizes a person's degree of functioning as a dynamic interaction between his or her health conditions, environmental factors, and personal factors and defines three aspects of functioning: body functions and structures, activities intended as the execution of a task or action by an individual, and participation, which is the involvement in a life situation. The activities and participation of ICF (WHO 2001) are classified according to nine dimensions: learning and applying knowledge, general tasks and demands, communication, mobility, self-care, domestic life, interpersonal interactions and relationships, major life areas, community, social, and civic life. In line with the WHO (2001), attention to what people with disabilities can do can facilitate their degree of participation, inclusion and quality of life (Wehmeyer, Shogren, and Kurth 2021). Thus, this study focused on typically developing children's knowledge of the functioning of peers with disabilities.

5 | Research Goal

Previous studies showed that children's knowledge of disabilities can be shaped implicitly by direct experience with peers with disabilities and explicitly by educational activities (e.g., Magiati, Dockrell, and Logotheti 2002). To reduce the potential effect of direct school experience with peers with disabilities, we conducted this study by involving typically developing children who attend classes without classmates with disabilities. Moreover, given the effect of formal school education on typically developing children's knowledge (Magiati, Dockrell, and Logotheti 2002), we considered the school grade level rather than the actual age, and we also controlled the potential effect of educational experiences and teaching practices inside each school class, considering the class as a cluster variable.

We investigated the effect of type of disability (HD, VD, MD and ID) and school grade level (1–8) on children's and preadolescents' knowledge of the causes of disabilities (Knowledge), potential misconceptions about the causes of disabilities (Misconceptions) and knowledge of the functioning of peers with disabilities in terms of activities they can perform (Functioning). We controlled the above-described analyses for gender because although no gender effects have been found on children's understanding of disabilities (Magiati, Dockrell, and Logotheti 2002), studies in other fields underline that boys tend to have more misconceptions than girls (Cahyanto, Ashadi, and Saputro 2019). We addressed the following research questions and tested the specified hypotheses. Does the type of disability and school grade level impact typically developing children's Knowledge, Misconceptions and Functioning? We hypothesized more accurate Knowledge of and lower Misconceptions about the MD and an increase of Knowledge of and a decrease in Misconceptions about four disabilities as the school grade level increases. Lastly, we hypothesized greater knowledge of the Functioning of children with MD and with the increase in school grade level.

6 | Method

6.1 | Participants

The study participants were a non-probability sample of 868 Italian typically developing children, aged 5 to 15 years (Table 1).

Twenty schools were identified by contacting a random sample of primary and lower secondary schools in northern Italy. A letter was sent to the school principals explaining the nature of the research project and requesting their participation. Fourteen schools participated to the research project. School principals selected the classes without students with disabilities, for a total of 50 classes, and the students were invited to join the research project through parental consent and voluntary participation. All the students of the selected classes participated in the research project.

6.2 | Measures

According to Ralli et al. (2011), to allow participants to articulate their knowledge of and misconceptions about disabilities,

TABLE 1 | Characteristics of participants according to gender and age.

		Gender		Age		
School grade level		**Boys, *n* (%)**	**Girls, *n* (%)**	**M**	**SD**	**Range**
1	$n = 101$	53 (52.5%)	48 (47.5%)	6.28	0.47	5–7 years
2	$n = 110$	51 (46.4%)	59 (53.6%)	7.45	0.50	7–8 years
3	$n = 108$	57 (52.8%)	51 (47.2%)	8.48	0.50	8–9 years
4	$n = 114$	55 (48.3%)	59 (51.7%)	9.52	0.50	9–10 years
5	$n = 117$	57 (48.7%)	60 (51.3%)	10.26	0.44	10–11 years
6	$n = 104$	56 (53.9%)	48 (46.1%)	11.56	0.52	11–13 years
7	$n = 104$	50 (48.1%)	54 (51.9%)	12.38	0.51	12–13 years
8	$n = 110$	57 (51.8%)	53 (48.28%)	13.53	0.52	13–15 years
Overall	$n = 868$	436 (50.2%)	432 (49.8%)	9.92	2.33	5–15 years

Note: In the Italian school system, grades 1–5 correspond to 5 years of primary school, and grade levels 6–8 correspond to 3 years of lower secondary school.

an interview was developed by two experts in developmental psychology and disability. The interview is the most suitable instrument for data collection among participants of different ages (Adams et al. 2007), and especially because first- and second-grade school level students might show difficulties in writing their answers or reading items. A face-to-face interview is more powerful in eliciting participants' understanding of disabilities in greater depth, allowing the researcher to ask clarifications (Knott et al. 2022).

Based on similar studies (i.e., Beneke 2021; Demetriou 2022; Diamond 2001; Magiati, Dockrell, and Logotheti 2002), the interview consisted of 16 images (eight boys and eight girls), depicting four children or preadolescents with VD, HD, MD and ID (see Appendix S1 for more information about the interview). The instructions and the images used to administrate the interview are reported in Table S1 and Figure S1, respectively.

The first part of the interview assessed the causes of four disabilities; the answers were classified as correct Knowledge when the causes identified were supported by the literature and Misconceptions when the answers referred to false beliefs and explanations without scientific support. The second part examined knowledge of the Functioning; only the answers in line with the nine dimensions of activities and participation proposed by the ICF (WHO 2001) were considered. For each disability, the number of activities was calculated.

Two raters independently examined the answers provided to both questions. For each of the disabilities, the two raters reached a level of agreement that exceeded 95%. Examples of answers are presented in Table 2.

6.3 | Procedure

The interview was administered in a private room of the school. It lasted approximately 10–20 min for each participant and was audio-recorded and then transcribed. Participants were shown images in random order of potential children with disabilities of the same gender and similar age, to minimize the effect of factors such as same-gender preference.

6.4 | Statistical Analyses

Preliminarily, we explored data from a descriptive perspective. We also checked for possible linear relationships between Knowledge, Misconceptions and Functioning by considering total scores for the three variables, regardless of the specific type of disability. Subsequently, we focused on the analysis of the effect of Type of Disability and School Grade Level on Knowledge (0 = *wrong response*, 1 = *correct response*), Misconceptions (0 = *not having a misconception*, 1 = *having a misconception*) and Functioning (the number of activities reported). Due to repeated measurement and nested data, mixed-effects models were applied with the GAMLj module of the JAMOVI statistical platform (Gallucci 2019; The Jamovi Project 2022). The effects of Type of Disability and School Grade Level and their interaction were estimated as fixed effects. Gender was also introduced as a control variable. For the random components, the intra-class coefficient (ICC) value, that is, the variance of the random intercept across the cluster variables, was estimated.

To evaluate the adequacy of the models, marginal R^2 (the variance explained by the fixed effects over the total variance of the dependent variable) and conditional R^2 (the variance explained by the fixed and the random effects together over the total variance of the dependent variable) were reported. To support the importance of including the random effects in the model, it is desirable that the overall model (fixed + random effects) captures a larger amount of the variance concerning the model, including only the fixed effects (Johnson 2014).

For Knowledge and Misconceptions, we conducted a generalized mixed model. The statistical significance of the effects was obtained by a Type III Wald chi-square test. For the variables showing significant effects, odds ratio (O.R.) were reported. For Knowledge, O.R. indicated the expected ratio between the probability of not giving and giving the correct response. For Misconceptions, O.R. indicated the expected ratio between the probability of having a misconception over the probability of not having a misconception. For Functioning, a linear mixed-effects model with restricted maximum likelihood estimation (REML) was conducted. To investigate the effect of School Grade Level, we conducted trend analyses by coding the School Grade Level variable with polynomial contrasts (from Grade 1 to Grade 8) that describe possible trends across the different types of disabilities. We investigated if the trend of School Grade Level was different between the categories of Type of Disability.

7 | Results

7.1 | Preliminary Analyses

Table 3 reports the descriptive statistics of Knowledge, Misconceptions and Functioning.

Regarding the bivariate correlations among the three variables, Knowledge was found to be negatively and significantly correlated with Misconceptions ($r = -0.36$, $p < 0.001$) and positively and significantly associated with Functioning ($r = 0.27$, $p < 0.001$). No linear relationship was found between Misconceptions and Functioning ($r = 0.06$, $p < 0.001$).

7.2 | Knowledge of the Causes of Disabilities

No significant difference between boys and girls in correct responses ($p = 0.229$) was found. Thus, gender was not included in the analysis. The marginal R^2 was 0.700, and the conditional R^2 was 0.760 (Table 4).

We found significant main effects of Type of Disability and School Grade Level. Post-hoc comparison tests evidenced a significant difference between HD and MD ($p = 0.022$) as well as VD ($p = 0.030$). For HD, the probability to give the incorrect answer was higher than for MD and VD. Significant differences were detected between Grade 2 and Grade 5, Grade 6, Grade 7 and Grade 8 ($ps < 0.001$). Grade 3 resulted in being

TABLE 2 | Examples of answers by type of disability.

Examples of correct answers about the causes of disabilities	
MD	• He has some physical problems because he was born with a disease or because he has suffered some traumas, so he cannot walk (Participant no. 534, male, grade 4). • She was born with malformations, or she got in an accident and got an injury to the spinal cord (Participant no. 662, female, grade 7).
VD	• She was born with an eye disease (Participant no. 136, female, grade 2). • He has a disease, a malformation that does not allow the optic nerve to carry the bioelectric discharge to the brain, and damage to the visual apparatus after birth, such as an accident (Participant no. 782, male, grade 8).
HD	• She was born like this, with an ear problem (Participant no. 407, female, grade 4). • He was born deaf, or his eardrums cracked in a serious accident (Participant no. 588, male, grade 6).
ID	• Because she was born with a DNA problem (Participant no. 477, female, grade 5). • Because when she has been fertilized there has been an error in the duplication of chromosomes (Participant no. 842, female, grade 8).
Examples of misconceptions about the causes of disabilities	
MD	• Because she has never learned how to walk (Participant no. 105, female, grade 2). • He may have gotten in an accident, or he has a leg in plaster (Participant no. 608, male, grade 6).
VD	• Because he watches too much television (Participant no. 19, male, grade 1). • He was born with problems; he has watched too much television and was always watching the phone (Participant no. 665, male, grade 7).
HD	• Because someone yelled in her ears (Participant no. 220, female, grade 3). • Maybe the music was too loud so he cannot hear anymore (Participant no. 605, male, grade 6).
ID	• Her mom had trouble giving birth (Participant no. 152, female, grade 2). • ... he had low oxygen to the brain (Participant no. 801, male, grade 8).
Examples of activities that participants think the peer can perform despite the disability	
MD	• She can go in a wheelchair (Participant no. 237, female, grade 3). • She can write, draw, and play with cards and that's it (Participant no. 602, female, grade 6).
VD	• Play (Participant no. 421, male, grade 4). • Sing (it is sufficient that she listens to the music and learns it), dance (she can invent a personalized dance just for her), study, have normal friends (Participant no. 793, female, grade 8).
HD	• He can play, and ride a bicycle, he can also eat, talk, and do homework (Participant no. 183, male, grade 2). • Read, write, observe, get dressed, do sport, sleep, study, watch a movie, play videogames (Participant no. 669, male, grade 7).
ID	• Write, study simple things, play, see (Participant no. 483, female, grade 5). • Do the main things but always with the help of another person: read, write, talk, listen, do sport, or have a hobby (Participant no. 791, female, grade 8).

significantly different from Grade 5, Grade 6, Grade 7 and Grade 8 ($ps < 0.001$). Students attending Grade 4 were expected to be significantly different in the Knowledge of peers attending Grade 7 ($p = 0.004$) and Grade 8 ($p < 0.001$). A significant difference also existed between Grade 5 and Grade 8 ($p = 0.036$). There was an increase in Knowledge as children progressed through school grades.

We also found a significant interaction effect Type of Disability × School Grade Level. For all disabilities, the effect of School Grade Level was significant ($ps < 0.001$). However, a trend analysis showed that School Grade Level had a significant and negative linear effect for MD ($B = -2.94$, $p < 0.001$), VD ($B = -2.79$, $p < 0.001$) and HD ($B = -2.26$, $p < 0.001$). The quadratic effect resulted to be significant for MD ($B = 0.87$, $p = 0.007$) and VD ($B = 1.04$, $p = 0.001$), but not for HD ($p = 0.247$). Neither a linear ($p = 0.642$) nor a quadratic effect ($p = 0.801$) was significant for ID (Figure 1).

7.3 | Misconceptions About the Causes of Disabilities

Gender was introduced as a covariate as significant differences emerged between boys and girls in preliminary analyses ($p = 0.010$, Cohen's $d = 0.079$). The marginal R^2 was 0.145 and the conditional R^2 was 0.318 (Table 5).

We found significant main effects of Type of Disability, School Grade Level and Gender. Post-hoc comparison tests indicated

TABLE 3 | Descriptive statistics for the total sample and differentiated by school grade level and gender, for each disability.

	Correct responses about the causes of disabilities			
	MD	**VD**	**HD**	**ID**
Total sample	39%	39%	31%	14%
Grade 1	8%	8%	11%	—
Grade 2	16%	19%	19%	3%
Grade 3	25%	23%	18%	3%
Grade 4	46%	40%	25%	3%
Grade 5	54%	61%	35%	7%
Grade 6	42%	46%	48%	26%
Grade 7	53%	52%	50%	25%
Grade 8	65%	59%	44%	50%
Boys	39%	36%	30%	15%
Girls	39%	41%	32%	14%

	Misconceptions about the causes of disabilities			
	MD	**VD**	**HD**	**ID**
Total sample	27%	13%	26%	24%
Grade 1	39%	10%	36%	100%
Grade 2	36%	24%	32%	34%
Grade 3	35%	14%	23%	31%
Grade 4	31%	22%	28%	25%
Grade 5	22%	8%	36%	25%
Grade 6	29%	12%	18%	18%
Grade 7	17%	5%	14%	13%
Grade 8	9%	8%	20%	12%
Boys	29%	14%	29%	25%
Girls	25%	12%	23%	24%

	Number of activities thought to be performed despite the disability							
	MD		**VD**		**HD**		**ID**	
	M	**SD (range)**	**M**	**SD (range)**	**M**	**SD (range)**	**M**	**SD (range)**
Total sample	1.47	1.34 (0–7)	1.15	1.25 (0–6)	1.44	1.49 (0–7)	1.35	1.58 (0–7)
Grade 1	0.50	0.50 (0–1)	0.24	0.45 (0–2)	0.45	0.50 (0–1)	0.48	0.50 (0–1)
Grade 2	0.92	0.80 (0–3)	0.55	0.63 (0–3)	0.81	0.83 (0–4)	0.75	0.96 (0–4)
Grade 3	0.67	0.49 (0–2)	0.44	0.52 (0–2)	0.63	0.49 (0–1)	0.63	0.49 (0–1)
Grade 4	1.63	0.94 (0–5)	1.31	1.10 (0–5)	1.79	1.21 (0–6)	1.50	1.34 (0–5)
Grade 5	1.88	1.25 (0–5)	1.54	0.98 (0–4)	1.68	1.20 (0–5)	1.58	1.42 (0–5)
Grade 6	2.06	1.58 (0–6)	1.84	1.50 (0–6)	2.13	1.75 (0–6)	2.23	2.06 (0–5)
Grade 7	1.97	1.52 (0–6)	1.61	1.42 (0–5)	1.88	1.85 (0–7)	1.68	1.93 (0–6)
Grade 8	2.04	1.77 (0–7)	1.65	1.58 (0–6)	2.10	2.04 (0–7)	1.88	2.03 (0–7)
Boys	1.43	1.29 (0–6)	1.13	1.24 (0–6)	1.40	1.49 (0–7)	1.34	1.60 (0–7)
Girls	1.49	1.39 (0–7)	1.17	1.25 (0–5)	1.47	1.50 (0–7)	1.34	1.56 (0–7)

TABLE 4 | Mixed model analysis predicting knowledge of the causes of disabilities.

Effect	χ^2 (*df*)	*p*	Post-hoc tests	O.R.[a]	SE
Type of Disability	11.3 (*3*)	0.010	MD	0.67	0.02
			VD	0.67	0.02
			HD	0.74	0.02
			ID	0.99	0.07
School Grade Level	99.9 (*7*)	<0.001	Grade 1	0.99	0.02
			Grade 2	0.91	0.02
			Grade 3	0.90	0.02
			Grade 4	0.82	0.04
			Grade 5	0.68	0.02
			Grade 6	0.62	0.05
			Grade 7	0.56	0.05
			Grade 8	0.45	0.05
Type of Disability × School Grade Level	81.0 (*21*)	<0.001			

Note: ICC for the random intercept for children = 0.174. ICC for the random intercept for school classes = 0.039.
[a]O.R. = the expected ratio between the probability of not giving and giving the correct response.

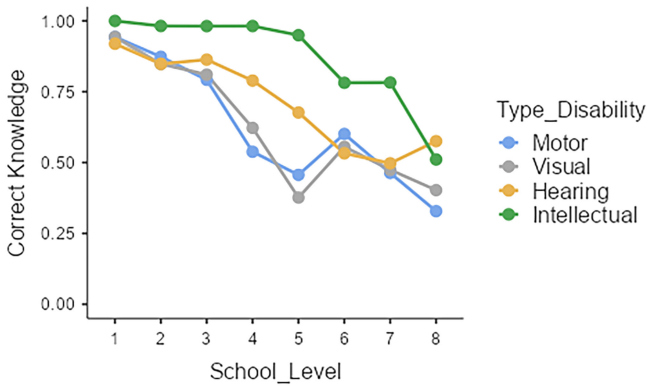

FIGURE 1 | Simple effects of school grade level on the probability of giving the incorrect response about the causes of the disability, by type of disability.

a significant difference between VD and MD, HD, and ID (*p*s < 0.001). It was less likely to have a Misconception about VD, and the probability of having a Misconception was lower in Grade 8 with respect to Grades 1 and 2. As for Gender, the probability of having a Misconception was higher in boys than girls ($p = 0.027$).

A significant interaction effect was found for Type of Disability × School Grade Level. For all disabilities, the effect of School Grade Level was significant: MD ($p < 0.001$), VD ($p = 0.007$), HD ($p = 0.015$) and ID ($p = 0.002$). The trend analysis revealed that with the progression of the school levels, there was a reduction of Misconceptions (Figure 2). However, the linear effect seemed to be higher for MD (B = −1.92, $p < 0.001$) and ID (B = −1.86, $p < 0.001$), with respect to VD (B = −1.25, $p = 0.006$) and HD (B = −1.19, $p = 0.002$) (Figure 2). The quadratic effects were non-significant for the four disabilities: MD: $p = 0.085$; VD: $p = 0.108$; HD: $p = 0.842$; ID: $p = 0.445$.

7.4 | Knowledge of the Functioning of Children With Disabilities

Gender was not included in the analysis as no significant differences between boys and girls emerged ($p = 0.181$). The marginal R^2 was 0.178, and the conditional R^2 was 0.678 (Table 6).

We found significant main effects of Type of Disability and School Grade Level. Post-hoc comparison tests indicated a significant difference between VD and MD, HD, and ID (*p*s < 0.001). A significant difference ($p = 0.020$) was also found between MD and ID. VD elicited the lowest number of activities, while MD elicited the highest number of activities.

Regarding the main effect of School Grade Level, no significant difference was detected by post-hoc comparison tests. A linear effect was significant and positive in MD: B = 1.51, $p < 0.001$; VD: B = 1.44, $p = 0.091$; HD: B = 1.57, $p < 0.001$; ID: B = 1.42, $p < 0.001$, with non-significant quadratic effects (MD: $p = 0.239$; VD: $p = 0.188$; HD: $p = 0.237$; ID: $p = 0.239$). Thus, with the progression of School Grade Level, there was an increase in Functioning (Figure 3).

8 | Discussion

This study aimed to examine the effect of type of disability and school grade level on typically developing students' knowledge of the causes of disabilities, potential misconceptions about the causes of disabilities, and knowledge of the functioning of CD in terms of activities they can perform.

We found that knowledge of the causes of disabilities differed depending on the type of disability, with ID being the least known. Only a small proportion of participants correctly explained the cause of Down Syndrome (e.g., 'because she was born with a

TABLE 5 | Mixed model analysis predicting misconceptions about the causes of disabilities.

Effect	χ^2 (*df*)	*p*	Post-hoc tests	O.R.[a]	SE
Type of Disability	63.35 (*3*)	<0.001	MD	0.22	0.02
			VD	0.09	0.01
			HD	0.21	0.02
			ID	0.19	0.02
School Grade Level	24.72 (*7*)	<0.001	Grade 1	0.26	0.06
			Grade 2	0.28	0.05
			Grade 3	0.22	0.05
			Grade 4	0.23	0.05
			Grade 5	0.18	0.04
			Grade 6	0.12	0.03
			Grade 7	0.09	0.03
			Grade 8	0.07	0.02
Gender	4.90 (*1*)	0.027	Boys	0.19	0.02
			Girls	0.15	0.02
Type of Disability × School Grade Level	42.85 (*21*)	0.003			
Gender × School Grade Level	5.72 (*7*)	0.573			
Gender × Type of Disability	1.39 (*3*)	0.709			
Gender × Type of Disability × School Grade Level	24.36 (*21*)	0.276			

Note: ICC for the random intercept for children = 0.112. ICC for the random intercept for school classes = 0.113.
[a]O.R. = the expected ratio between the probability of having a misconception over the probability of not having a misconception.

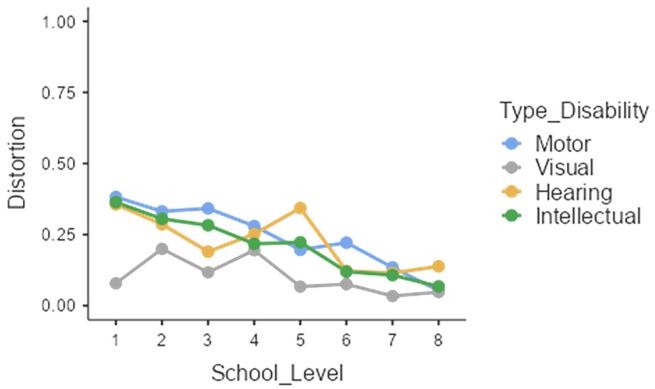

FIGURE 2 | Simple effects of school grade level on the probability of having a misconception about the causes of the disability, by type of disability.

genetic disease'), whereas the majority of participants attributed it to misconceptions (e.g., 'he had an accident' or 'he comes from another country and does not understand'). This result is in line with Magiati, Dockrell, and Logotheti's (2002) study, which highlighted the difficulty in comprehending the least evident disabilities, such as ID, particularly for younger children. The analyses also showed that it was more difficult to give the correct answer in the case of HD. As underlined by Bicego (2023), this could be because HD is often invisible and rarely discussed except as an aspect connected to other more complex disabilities. A greater knowledge of the causes of disabilities was also found from primary to secondary school, confirming a developmental growth in older participants' knowledge (e.g., Babik and Gardner 2021; Magiati, Dockrell, and Logotheti 2002). This positive trend was generally confirmed considering the interaction effects.

For misconceptions about the causes of disabilities, there was an effect associated with the type of disability, with VD having a lower tendency to report distorted perceptions of the cause than the other types. Participants more frequently reported false explanations for MD (e.g., 'the child still has not learned how to walk'), HD (e.g., 'because he heard the loud music on the radio'), ID (e.g., 'he feels sick'), than VD (e.g., 'because she watches too much television and goes to the movies too much'). This result represents a main contribution of the study, especially as no other studies have examined the trend in misconceptions about the causes of different disabilities. A possible explanation may be that VD is generally more known compared with HD and ID. Furthermore, even though the causes of VD are as well-known as those of MD, participants frequently reported superficial explanations, associating MD with temporary situations such as ankle sprains or limb fractures (e.g., 'because he fractured his leg') (Magiati, Dockrell, and Logotheti 2002). We also found a significant difference between the first two grades of primary school

TABLE 6 | Mixed model analysis predicting the number of activities thought to be performed despite the disability.

Effect	*F* (*df*)	*p*	Post-hoc tests	Expected mean	SE
Type of Disability	25.75 (*32580*)	<0.001	MD	1.44	0.13
			VD	1.13	0.13
			HD	1.42	0.13
			ID	1.33	0.13
School Grade Level	3.42 (*7, 45.3*)	0.005	Grade 1	0.42	0.36
			Grade 2	0.83	0.31
			Grade 3	0.47	0.31
			Grade 4	1.57	0.36
			Grade 5	1.76	0.31
			Grade 6	1.91	0.36
			Grade 7	1.88	0.39
			Grade 8	1.77	0.39
Type of Disability × School Grade Level	1.17 (*21, 2580*)	0.272			

Note: ICC for the random intercept for children = 0.317. ICC for the random intercept for school classes = 0.522.

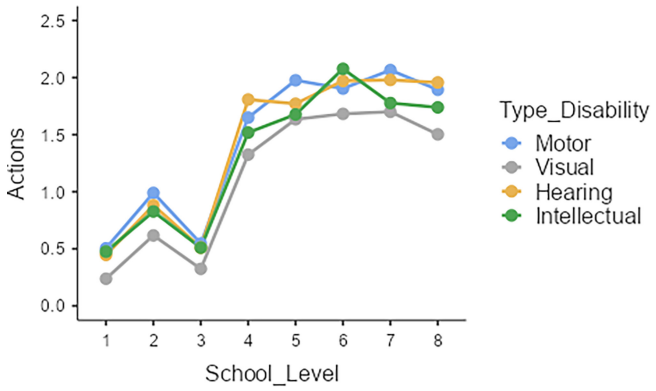

FIGURE 3 | Simple effects of school grade level on the number of activities thought to be performed despite the disability, by type of disability.

compared with the last grades of lower secondary school. Overall, the trend involved a decrease in misconceptions with an increase in school grade level; this may be attributed to greater educational school activities that may promote a significant decrease in false explanations regarding the causes of disabilities (Babik and Gardner 2021).

For knowledge of the functioning of children with disabilities, participants reported slightly less frequently the activities of potential peers with VD (e.g., 'he can play with the ball') compared to other disabilities. As stated by the Italian Ministry of Education, Universities and Research [MIUR] (2022), VD is the least frequent disability during the years of schooling compared with HD, MD and ID. This result suggests that typically developing children are likely to have few opportunities to see peers with VD in a variety of social contexts and detect their functioning. Moreover, results underscored a higher tendency to detect a higher number of activities that participants believe the peer can perform despite the disability with the increase in school grade. According to Babik and Gardner (2021), non-significant quadratic effects indicated that the trend is constantly increasing.

The study showed a significant effect of gender only for misconceptions, with boys reporting more distorted perceptions of the causes of disabilities than girls. These results confirmed previous studies where no gender effects on children's understanding of disabilities were found (Magiati, Dockrell, and Logotheti 2002); however, they reinforced studies in other fields that found that boys tend to be more susceptible to cognitive distortions than girls (Cahyanto, Ashadi, and Saputro 2019).

Overall, findings confirmed and advanced the model proposed by Babik and Gardner (2021), suggesting that better comprehension of disabilities may be the result of general cognitive development. Specifically, this increase may be due to advance in school grade level and education, particularly during the lower secondary school years, which involved teaching of basic elements of genetics that may help typically developing children understand the causes of some disabilities. Nevertheless, a substantial proportion of preadolescents in the eighth grade did not have accurate knowledge of the causes of the four disabilities, with a number of participants with misconceptions especially regarding HD. There was also an overall difficulty in detecting the positive functioning of children with disabilities, with a maximum of seven activities reported.

This study contributes to the literature in several ways. Firstly, it examined knowledge of the causes of disabilities, involving children starting from primary school up to lower secondary school. Secondly, it contributed to examining knowledge of more evident disabilities such as VD, HD and MD and more complex ones such as ID. Thirdly, it examined potential misconceptions about the

causes of these disabilities. Lastly, it examined for the first time typically developing children's knowledge of the functioning of peers with disabilities. Focusing on the functioning rather than the limitations associated with the disability can be particularly useful in facilitating the inclusion of classmates (Wehmeyer, Shogren, and Kurth 2021; WHO 2001).

This study demonstrates that typically developing children have a rudimentary and limited understanding of disabilities, suggesting the necessity of specific intervention programs to reinforce knowledge of disabilities. The meta-analysis conducted by Chae, Park, and Shin (2019) suggests that the implementation of school-based interventions for improving understanding of disabilities is very effective in promoting this conceptual cognitive change and it promotes more positive attitudes towards disabilities. Such school-based interventions should aim both to provide accurate knowledge of the causes of disabilities and to analyse and demolish misconceptions about disabilities. In line with the ICF (WHO 2001), emphasis should also be given to the analysis of the functioning of children with disabilities, examining abilities that these may have, how they can participate in school activities, and the strategies and supports typically developing children could use to encourage classmates with disabilities' activities and participation (Ginevra et al. 2020).

Several limitations of this study were identified. No questions were administered about the source of their knowledge or the degree of knowledge and misconceptions about the causes of disabilities. Knowing the source of the knowledge and the degree could be useful to plan and implement appropriate interventions to promote children's knowledge of disabilities, considering also their contexts (i.e., how the issues related to disability are discussed in the familial or school context, explicit educational activities about disability). Secondly, this study did not gather further information regarding the general experiences of participants with peers with disabilities (e.g., in their family or social contexts). This variable should be investigated in further studies to control the potential effect of direct experiences with siblings or friends with disabilities. Thirdly, only four disabilities were considered, and for ID, only Down syndrome was examined. Further research should analyse other disabilities, especially those representing more complex disorders. Finally, although this study used a large sample of typically developing students, future studies could involve participants from different Italian areas to guarantee the generalizability of the results to the broader Italian population of same-age children.

Author Contributions

Maria Cristina Ginevra: conceptualization, data curation, investigation, writing – original draft. **Maria Anna Donati:** formal analysis, writing – original draft. **Isabella Valbusa:** investigation, writing – original draft. **Caterina Primi**: writing – review and editing. **Sara Santilli:** writing – review and editing. **Laura Nota:** conceptualization, supervision.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data necessary to reproduce the analyses presented here are not publicly accessible. However, the data that support the findings of this study are available from the corresponding author upon reasonable request. The analytic code necessary to reproduce the analyses presented in this paper is not publicly accessible. However, the analytical code can be requested by the first author. The materials necessary to attempt to replicate the findings presented here are not publicly accessible. However, all materials can be requested by the first author. The analyses presented here were not preregistered.

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Supporting Information

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