





Muddy Children Puzzle: Formulation



Consider *n* children playing outdoors together. Suppose *k* of them get mud on their foreheads. Each of the *n* children can see which of the other n - 1 children are muddy or not, but, of course, can't be sure whether s/he is muddy.

- The father shows up and announces: "At least one of you has mud on his/her forehead."
- The father then asks: "Does any of you know whether s/he has mud on her/his forehead?"
- After the *k*-th such question, all the *k* muddy children will answer "Yes!".

Nebel, Lindner, Engesser - MAS

Interesting Questions



- Did the father tell the children anything new in the first announcement?
- Why is it that all the muddy children simultaneously know the answer to question (2) after exactly k rounds?

Nebel, Lindner, Engesser - MAS

5/19



Base Case I	BURG
	FRE
Case $k = 1$	
The muddy child only sees clean children. And a children see one muddy child.	all clean
 Muddy child considers possible: 0 or 1 children Clean children consider possible: 1 or 2 childre 	n are muddy. en are muddy.
 After the father announces that at least one of th muddy: 	hem is
 Muddy child considers possible: 1 muddy. Clean children consider possible: 1 or 2 muddy 	<i>ı</i> .
The father asks who knows to be muddy:	
Muddy child knows!	
Nebel, Lindner, Engesser – MAS	6 / 19



















16 / 19

Summary and Outlook



- Public communication and observations change what is common knowledge among agents ⇒This kind of dynamics can be modeled using the Public Announcement Operator.
- Public Announcement Logic can be translated to Epistemic Logic.
- Next Lecture: Logics-based specification of BDI agents (a modal-logics based theory of actions, beliefs, goals, intentions).

Nebel, Lindner, Engesser - MAS

17 / 19



