Introduction
Adults1,2, young children3 and even 6-10 to 9-months old4 babies see causality in at least two types of schematic events. If A moves towards B, which moves immediately upon contact, adult observers report that A launches B - physical causality. If B moves before contact, so that both shapes move simultaneously for some time, they report that A tries to escape from A, i.e., B reacts to A - social causality. The perception of social causality in this event implies an appreciation of the goal-directedness of the agent. In both kind of events the causal impression is destroyed if a temporal pause (delay) is introduced between the motion of A and the motion of B, that is if the temporal continuity is interrupted.

Perceptual causality in development
Infants as young as 6 months are already sensitive to the causal structure in launch and reaction events, this is important because structured perception in infancy can operate in absence of prior knowledge or experience, therefore it may support the development of mature inferential processes of causal understanding. In this framework it has been suggested that the perception of contact causality can promote learning about mechanical interactions of material bodies5-7, while the perception of non-contact causality could promote learning about the social interactions of intentional agents8 and, in this sense it could be a precursor to the development of Theory of mind abilities.

Perceptual causality and Autism
Autism (DSM IV, 1994) is a pervasive developmental disorder characterized by
• Qualitative impairments in social interactions
• Qualitative impairments in communication (verbal and non-verbal)
• Repetitive and restrictive patterns of behaviour, interests and activities.
Together with a high incidence of particular skills inselective areas like drawing, visuo-spatial construction, attention for details, music, calculation, memory, and sensory as well as perceptual peculiarities.

It has been suggested that children with autism may have an impairment with perceptual causality at various age8,9. An early problem could emerge during infancy, it may be still evident during childhood and it could have developmental consequences on understanding of intentional beings and non animates agents.

Existing theories make distinctive predictions, but previous work has led to conflicting results.

A problem in the perception of reaction events could be compatible with poor early social motivation and it could be linked to later problems in social cognition. Toddlers and children with autism show poor attention to social stimuli, (voices, language, people, faces), and this is likely to affect their social development. If children with A, had a problem with Perceptual Causality during infancy this would further reduce their possibilities to learn and become experts of causal interactions and consequently of the differences in the behaviour of non-animate objects and that of animate agents.

As early problem in the perception of reaction events could concur to create the deficits in social cognition and interaction emerging later during childhood. Klin10 reported that adolescents and adults with autism have problems in the individuation and verbal description of social elements present in Heider and Simmel11 complex animations in which three geometrical shapes interact by contact or at a distance. In another study Bowler and Thommen12 coherently with Klin report problems in the description of non-contact interactions in complex animations. They didn’t find problems in the differentiation of launch and reaction events, however this result is questionable since it is not clear if children differentiated the events according to causality or according to spatial criteria since the test didn’t include non-contact causality. Moreover, the reaction event was not adequate to test causal perception since also typically developing children describe different cause animations in spatio-temporal than causal terms.

A problem in the perception of causal Gestaltst in general depend on the bias towards detail-based instead of global processing of information that characters autism at the perceptual level, however previous findings haven’t supported this hypothesis.

Finally a problem in the perception of launching but not reaction events could depend on the duration of the causal interaction, which is longer in reaction than launch. This factor could affect the perception of reaction events in an attentional shift or because in subtle global processing requires more time than local processing. Ray and Schlottmann13 using a picture-choice non verbal answer method (idealized for young children14) reported a problem with the perception of launch but not reaction events in a group of young children with autism and suggested that the short duration of the contact in such an event could be at the origin of this result.

Differences in methodology, in the stimuli and in the characteristics of the subjects could have produced these discrepant results. The present study aims to overcome some methodological problems and it was designed to Address specific questions originated by the results of previous studies.

Results
The performance of children with autism was comparable to that of the typically developing controls.

The study didn’t highlight any deficit in the perception of launch or reaction in contrast to previous work. Children with autism answered in a mature fashion, being able to use principally the temporal information to distinguish causal from non-causal events and the spatial configuration to differentiate physical from social causality.

In the rigid-motion condition overall the children in the two groups chose the collision picture for the launch event and the chasing picture for the reaction event. The events with delay were mostly associated to the non causal picture. The ambiguous event received more physical attributions by children with autism and more social attributions by the controls.

In the non-rigid motion condition the problem of answers is largely similar: the answers reflect still a main tendency to attribute physical causality to the launch, social causality to the reaction stimulus and to associate the non-causal picture to both the delay conditions, but compared to previous condition, the purple bars show that more social attributions appear throughout for all events (i.e., the entering), as an effect of the non-agent, and of the verbal prompt. In the other hand the blue bars show a general decease in the attribution of physical causality.

Conclusions
The results suggest that deficits in the perception of the launching event found in younger children by Ray and Schlottmann13 could be overcome with age and/or higher verbal functioning. The fact that we didn’t rule out the hypothesis of a problem in PC during early infancy, instead they could indicate a delay in the emergence of this ability: the problem is not present in older children, while signs of an impairment are evident in younger ones. Moreover the good verbal level allowed more detailed instructions that could have boosted the overall performance. This highlights the need to include younger and less verbal children with autism in future studies to investigate the possible sources of any deficit in PC.

The weak performance found by Bowler and Thommen12 and by Thommen et al.14 is not consistent with the high performance of children (in both groups) in the present study and might thus reflect difficulties due to the high verbal demands of their test. Finally, specific difficulties on social animations may only appear for more complex stimuli15 and this highlights an important difference between simple causal stimuli and more complex ones. While reaction events points towards mental state reasoning, they don’t necessarily require mentalising, these events can be described in goal-directed and in the contrast rather than mental state terms, and children ASD and in some cases capacity to describe goal-direction16. Therefore Intact perception of reaction causality is entirely consistent with deficits in mental state reasoning. Some stimuli might be used to teach children with Autism who pay scarce attention to normal human social stimuli, because these animations can portray reciprocal social interactions without them.