

# How to visualise the invisible – new video-based eyetracking paradigm “PILK!” for children aged 3 to 4.

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## Summary

A socially competent child achieves his communication goals while being sensitive to social cues of his communication partner (Guralnick, 1999; Howes & James, 2002), forms friendships more efficiently and is more likely to be successful at school (Raver, 2002). Crick and Dodge’s (1994) model of social competence describes how a child enters a social situation with biologically determined skills, previous experience, and knowledge of how social situations function. In a social situation, a child selectively focuses his attention to different social signals, interprets those, chooses the communication goal (e.g. to get the toy from another child) and chooses between previously experienced or new behaviours and the final decision depends on which behaviour has most likely the positive result (Crick & Dodge, 1994). According to Beauchamp and Anderson’s (2010) SOCIAL model the underlying processes of social competence are higher cognitive (attention, executive functions, communication, social-emotional skills) and lower sensory functions, which in turn are affected by internal biological and environmental factors. In their model of social competence Beauchamp and Anderson (2010) emphasise the role of nonverbal communication signals.

During face-to-face interaction, the communication partners continuously and synchronously exchange different social cues like eye gaze, gestures and facial expressions (Cañigüeral & Hamilton, 2019). Even if those social signals emerge only during milliseconds without us being aware of them, they affect how a person interprets social situations (Vinciarelli et al., 2009). The gaze is considered the most unique and powerful social cue (Birmingham & Kingstone, 2009). In every face-to-face interaction, people receive and give information using planned eye movements (Cañigüeral & Hamilton, 2019). If while

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observing static photos people tend to fixate their gaze more on the eyes (Klin et al., 2002), then during dynamic interactions people tend to look in the direction of the eye gaze of their communication partners (Yu & Smith, 2013). The role of gestures is more controversial, but it seems that co-speech gestures, deictic gestures and symbolic gestures have different roles in perceiving social situations. Co-speech gestures most likely draw attention to speech and carry the meaning of kindness, closeness, the sense of belonging (Spengler et al., 2017). Symbolic gestures can have their own meaning independent from context and act like a word (Xu, Gannon, Emmorey, Smith & Braun, 2009). Deictic gestures play an essential role in language development (Iverson & Goldin-Meadow, 2005; Rowe & Goldin-Meadow, 2009). The ability to recognise emotions and interpret those is also an important factor in general social competence (Philippot & Feldman, 1990; Crick & Dodge, 1996). People who perceive emotions more accurately also describe their relationships as more supportive than those whose ability to perceive emotions is less accurate (Ciarrochi et al., 2001). All the social interactions are regulated by turn-taking which is the ability to coordinate the social signals and when most transitions between talkers go smoothly and extremely rapidly (Vinciarelli et al., 2009; Bögels & Levinson, 2017; Ho et al., 2015).

Most children in Estonia aged 3 to 4 have entered into the education system and face important challenge in cooperating with other children in a group setting. At that age the skills of the theory of mind start to develop (Gopnik & Astington, 1988), children form their first true friendships, learn to share toys and recognise emotions (Halle & Darling-Churchill, 2016). Difficulties in perceiving socially relevant signals can lead to socially unacceptable behaviours. The teacher has a vital role in developing social competence if needed, but Estonian teachers feel most insecure facing behavioural problems and learning difficulties (Häidkind & Oras, 2016).

The usual paper-pen assessment tools for social competence describe behavioural clusters but tells very little about what causes such behaviours and most assessment tools are designed for children over six years of age (Crow et al., 2011). Thus there is a need for new dynamic interactive assessment methods for assessing specifically the social perception (McDonald, 2012). The eye gaze technology is excellent for objectively measuring the social perception and showing how people divide their attention between socially relevant stimuli. For example, studies conducted using eye-gaze technology show atypical looking patterns of children with autism (Papagiannopoulou et al., 2014; Rice et al., 2012; Rogers et al., 2014).

For those reasons, a new videobased assessment eye-tracking paradigm “Pilk!” was created. The paradigm consisted of 13 original videos. Within those

videos, the areas of interest were defined to assess how children direct their attention to socially relevant stimuli (gaze, gestures, emotions, turn-taking). The current study was aimed to find out if paradigm “Pilk!” with its defined areas of interests is appropriate for assessing different sub-components of social competence and if changes are needed to improve the paradigm. A total of 18 neuro-typically developing children ( $M=47,1$  month,  $SD=7$  months; eight boys and ten girls) from Tallinn and Harju County were recruited. The study was conducted in a laboratory at Tallinn University. While children were looking at the videos, their fixations to previously defined areas of interests were recorded with Tobii X3-120 eye-tracker. Parents completed the Ages and Stages Third and Ages and Stages: Social-Emotional Second Edition questionnaires to establish their children’s general development.

Results of the study showed that children with better problem-solving skills fixated their gaze more to socially relevant signals. The study also demonstrated that the fixations patterns were largely related to the context in which stimuli was presented. The fixation on objects or face was dependent on the gaze direction of the person observed by the participants. If the gaze was directed to the object, the participants also fixated their gaze more on the object. Additionally, our study showed that the fixation on gestures was related to the type of gestures presented in the videos. Our participants fixated their gaze to co-speech gestures only marginally, but the symbolic gestures got as much attention as the face. Compared to neutral stimuli, our participants fixated their gaze to the face, which expressed the emotion or potential reaction. Altogether 8 of 12 videos and its’ areas of interests were entirely or partially suitable for assessing social competence sub-mechanisms. Therefore, we conclude that after making appropriate improvements the paradigm “Pilk!” can be complementary for existing assessment tools of social competence and will establish the social perception patterns of children with different diagnosis in the future.

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