

applies only to surprises that alter or prevent customary actions. It does not make sense to talk about “resolving” a novel aspect.

3.4 Variety

When designing for young children with ASC in general, ECHOES findings suggest incorporating a wide *variety* of DDOs, including “something for everyone”, whether a child needs hands-on interaction, notices novelty but not surprises, or only likes sound effects. Each child can detect and react to *some* opportunities, meaning that the overall design strategy can still be of benefit even when individual users’ patterns of interest and activity are quite different. This recommendation stems from the ECHOES observation that particular discrepancies of great interest to some children were *completely unnoticed* by others. There was strikingly little overlap between children in the sets of discrepancies they detected, plus wide variation in their *breadth* of interest (a range from 8 to 21 types of discrepant aspects). Only *one* aspect motivated all children to initiate: discovering that a usually responsive object was now unresponsive.

The lack of overlap would be problematic *if* children had reacted positively to “favourite” discrepancies and been upset by others. This was not the case: they laughed and shared excitement about favourites, with visible but more neutral reactions elsewhere. The lack of negative reactions to discrepancy may be related to *flexibility* of interaction: In ECHOES, children almost always had options within the VE, and were not “forced” to interact with or resolve specific [potentially disinteresting or threatening] aspects. Without this flexibility, negative reactions might increase.

3.5 Frequency of DDOs

As noted in 3.4, there was relatively little overlap in the aspects children detected as discrepant—what fascinated some was invisible to others. The highly *subjective* nature of discrepancy means that designers can include a fairly high number of DDOs without worrying about creating chaos—only some of them will “exist” to any one child. Current ECHOES videos can help us to estimate how many DDOs to use in the future. Children detected 236 unique discrepancies (129 surprises and 107 novel aspects) in 347 minutes of video. On average, this is a surprise detected every 2.7 minutes and a novel aspect every 3.2 minutes. A 12-minute session could thus include *at least* 4-5 surprises *and at least* 3-4 novel aspects while still maintaining high overall integrity. “At least” is emphasized as it is highly unlikely that a child would take up all opportunities. Designers need to include enough DDOs, with enough variety, for every child to be interested in a subset of them (e.g. planning 10 surprises and 8 novelties in a session, expecting that children may react to half).

3.6 Ambiguity

A strong potential benefit of deliberate DDOs as a design strategy is that they enable interesting and open-ended communicative *opportunities*, to which the child can react for any purpose, using any relevant behaviour. For example, after observing Andy make a mistake (Figure 1) it is equally relevant and appropriate to initiate by correcting him, by commenting and pointing, or by sharing laughter with the researcher. The alternative to such ambiguous motivators is embedding specific communicative *demands*, (e.g. giving a child a broken pencil with which to write her name “demands” an initiation to request another; see [5, 6]). The *flexibility* principle grants children some freedom of action. *Ambiguity* seeks to enable freedom of *reaction*. With respect to

facilitating initiation, these ambiguous opportunities seem more like “daily life” situations than do specific demands, possibly forming a more likely basis for skill generalisation (as yet an untested hypothesis). From a research standpoint, ambiguous DDOs offer a valuable window into the interests and attentional focus of young children with ASC, illuminating the often-significant gaps between the adult designer’s intentions and the child’s experience of the interaction.

4. ONGOING & FUTURE WORK

Previous work [7] has established discrepancy-detection as a promising phenomenon. This paper takes the first steps toward developing it as a design strategy. Many unknowns remain regarding the relative motivational effectiveness of specific discrepancies and the types of initiations which result. Ongoing work with the ECHOES dataset seeks to answer these questions and to generate more specific, low-level recommendations. A parallel line of analysis is investigating patterns of discrepancy-detection within and across children, developing a small set of design personae representing different styles of child-system interaction as a resource for personalising technologies at a “profile” level, rather than the one-size-fits-all approach here.

The next phase of research will be to implement these recommendations in new activities and test how they work in practice. Ideally, this will broadly replicate the existing patterns of DR pairs, provide proof-of-principle that DDOs can motivate communication, and yield information about the extent to which this phenomenon generalises across participants and contexts of use. The end goal of the current and planned work is a robust and flexible collection of design strategies applicable to motivating initiations in interactive technologies for ASC.

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