In future work, we will extend the matching algorithm so that merging of segments is performed. In the presented system, we show in an exemplar way how the concept of compositionality can be integrated into CV algorithms and, by making use of well-approved segmentation and graph-matching methods, a simple visual representation can be achieved that is coherent over time.

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Control and flexibility of interactive alignment: Möbius syndrome as a case study

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When we interact with others, there are many concurrent layers of implicit bodily communication and mutual responsiveness at work—from the spontaneous temporal synchronization of movements (Richardson et al. 2007), to gestural and postural mimicry (Chartrand and Bargh 1999; Bernieri and Rosenthal 1991), and to multiple dimensions of linguistic coordination (Garrod and Pickering 2009; Clark 1996; Fusaroli and Tylen 2012). These diverse processes may serve various important social functions. For example, one individual's facial expressions, gestures, bodily postures, tone and tempo of voice can provide others with information about her emotions, intentions and other mental states, and thereby help to sustain interpersonal understanding and support joint actions. And when such information flows back and forth among two or more mutually responsive participants in an interaction, the ensuing alignment can promote social cohesion, enhancing feelings of connectedness and rapport (Lakin and Chartrand 2003; Bernieri 1988; Valdesolo et al. 2010). Indeed, by enhancing rapport, interactive alignment may also increase participants' willingness to cooperate with each other (van Baaren et al. 2004; Wiltermuth and Heath 2009) and—equally importantly—their mutual expectations of cooperativeness even when interests are imperfectly aligned, as in scenarios such as the prisoners' dilemma (Rusch et al. 2013). Moreover, interactive alignment may even enhance interactants' ability to understand each other's utterances (Pickering and Garrod 2009) and to communicate their level of confidence in their judgments about situations (Fusaroli et al. 2012), thereby enhancing performance on some joint actions. Finally, interactive alignment may also increase interactants' ability to coordinate their contributions to joint actions (Valdesolo et al. 2010) because synchronization increases interactants' attention to one another's movements, and because it may be easier to predict and adapt to the movements of another person moving at a similar tempo and initiating movements of a similar size, duration, and force as oneself.

It is no surprise, then, that recent decades have seen a dramatic increase in the amount of attention paid to various kinds of interactive alignment in the cognitive sciences. However, although there is a broad consensus about the importance of interactive alignment processes for social interaction and social cognition, there are still many open questions. How do these diverse processes influence each other? Which ones contribute—and in what ways—to interpersonal understanding, cooperativeness and/or performance in joint actions? Is alignment sometimes *counter*productive? To what extent can alignment processes be deliberately controlled and flexibly combined, replaced, tweaked or enhanced? This latter question may be especially relevant for individuals who have impairments in some form of bodily expressiveness, and who therefore may benefit by compensating with some other form of expressiveness. In the present study, we investigated social interactions involving just such individuals, namely a population of teenagers with Möbius Syndrome (MS)—a form of congenital, bilateral facial paralysis resulting from maldevelopment of the sixth and seventh cranial nerves (Briegel et al. 2006).

Since people with MS are unable to produce facial expressions, it is unsurprising that they often experience difficulties in their social interactions and in terms of general social well-being. We therefore implemented a social skills intervention designed to train individuals with facial paralysis owing to MS to adopt alternative strategies to compensate for the unavailability of facial expression in social interactions (e.g. expressive gesturing and prosody). In order to evaluate the effectiveness of this intervention, each of the 5 participants with MS ('MS-participants') engaged in interactions before and after the intervention with partners who did not have MS ('Non-MS-participants'). These social interactions consisted of two separate tasks, a casual getting-to-know-you task and a task designed to tap interpersonal understanding. Participants filled out rapport questionnaires after each interaction. In addition, the interactions were videotaped and analyzed by independent coders, and we extracted two kinds of linguistic data relating to the temporal organization of the conversational behavior: prosody (fundamental frequency) and speech rate. We used this latter data to calculate indices of individual behavioral complexity and of alignment using cross-recurrence quantification analysis (CRQA).

We found several interesting results. First, intervention increased observer-coded rapport. Secondly, observer-coded gesture and expressivity increased in participants with and without MS after intervention. Thirdly, fidgeting and repetitiveness of verbal behavior decreased in both groups after intervention. Fourthly, while we did in general observe alignment (compared to surrogate pairs), overall linguistic alignment actually decreased after intervention, and pitch alignment was negatively correlated with rapport.

These results suggest that the intervention had an impact on MS interlocutors, which in turn impacted non-MS interlocutors, making them less nervous and more engaged. Behavioral dynamics can statistically predict observer-coded rapport, thus suggesting a direct link between them and experience of the interaction.

This pattern of findings provides initial support for the conjecture that a social skills workshop like the one employed here can not only affect the participants with MS but also—and perhaps even more importantly—affect the interaction as a whole as well as the participants without MS. One reason why this is important is because some of the difficulties experienced by individuals with MS in social interactions may arise from other people's discomfort or uncertainly about how to behave. In other words, individuals without MS who interact with individuals with MS may interrupt the smooth flow of interaction through their uncertainty about how to interact in what is for them a new and sensitive situation. Moreover, this may also be true in other instances in which people interact with others who appear different or foreign to them (because of other forms of facial difference, skin color, etc.) Thus, this issue points to a possible direction in which further research may be conducted that would extend the findings far beyond the population of individuals with MS. More concretely, one obvious comparison would be to individuals with expressive impoverishment due to Parkinson's disease. Do these individuals also employ some of the same kinds of compensatory strategies as individuals with MS? If so, what effects does that have upon interactive alignment within social interactions? What differences does it make that their condition is an acquired rather than a congenital one?

Finally, one additional question for further research is whether some compensatory strategies are more easily automated than others. For example, it is possible that increasing hand gesturing or eye contact can be quickly learned and routinized, but that modulating one's prosody cannot. If there are such differences among the degrees to which different processes can be automated, it would be important to understand just what underlies them. On a theoretical level, this could provide useful input to help us understand the relationship between automatic and controlled processes. On a more practical level, this could be important for three concrete reasons. First of all, it may be taxing and distracting to employ deliberate strategies for expressing oneself in social interactions, and people may therefore find it tiring, and be less likely to continue doing it. Secondly, it may be important that some interactive alignment processes occur without people's awareness. Thus, attempting to bring them about deliberately may actually interfere with the implicit processes that otherwise generate alignment. Indeed, there is evidence that behavioral mimicry actually undermines rapport if people become aware that it is being enacted deliberately (Bailensen et al. 2008). Thirdly, it would be important for future social skills workshops to examine whether some compensatory strategies are more effectively taught indirectly—e.g. rather than telling people to use more gestures, it may be advantageous to employ some other means which does not require them to deliberately attend to their gestures or prosody, for example by using more gestures and prosody when interacting with children with MS, by asking them to watch videos in which actors are highly expressive in their gestures and prosody, or by engaging them in role-playing games in which a high level of gesture and/or prosody is appropriate.

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