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Like Me – The Influence of Movement Congruency and Contingency on Empathy and Prosocial Behaviour

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THE INFLUENCE OF MOVEMENT CONGRUENCY AND CONTINGENCY ON EMPATHY AND PROSOCIAL BEHAVIOUR

Abstract

Recent studies have shown that interaction partners show a tendency to automatically imitate each other, which has positive effects on liking. This phenomenon is called “the Chameleon effect”. The aim of the current study was to assess whether imitation also affects empathy and prosocial behaviour and to clarify the functional mechanisms that drive this phenomenon. Based on previous findings two explanatory models will be discussed in detail: the action-perception link and the contingency hypothesis. Participants took part in a presumably interactive online game with two co-players where their arm movements were imitated by one of the co-players. They received, and observed the co-players receiving, painful stimulations afterwards. Empathy was measured using behavioural ratings, facial EMG, the startle response and the skin conductance response. In the end, participants were assigned to select one of the co-players for helping. Their preference for one co-player as well as the decision concerning on whose behalf they would take the painful stimulation was assessed with a forced-choice task and was a measure of whether imitation affects prosocial behaviour. Behavioural data showed that movement congruency has a positive effect on prosocial behaviour, but not on empathy. EMG data showed no influence of pain or imitation; only activation of M. corrugator supercilii tended to be more negative within the non-pain congruent condition, but no interaction within other factors has been found. Startle amplitudes did not differ across conditions. Our findings suggest that motor imitation elicits prosocial behaviour but does not affect empathy, which is why more precise factors are needed when exploring empathy.

Keywords: Chameleon effect; Action and perception; Empathy; Imitation; Congruency; Contingency; Prosocial behaviour; Facial electromyography (fEMG); Startle response; Pain

THEORETICAL BACKGROUND

Social interactions are very complex processes mediated by various conscious and unconscious factors. These interactions have an influence on us, human beings, and as a result make us change opinions, take decisions and experience a wide range of feelings. Thus, many researchers have dedicated their work examining these complex social processes.

The Chameleon effect

One of the most important findings is the “Chameleon effect” by Chartrand and Bargh (1999), according to which humans have a tendency to unconsciously imitate the behaviour and the mannerisms of their interaction partner. A number of follow-up studies have replicated the effect and emphasized the different shapes and levels of imitation, i.e. people mimic whole body movements (Bernieri, Reznick, & Rosenthal, 1988; Chartrand & Bargh, 1999; Sparenberg, Topolinski, Springer, & Prinz, 2012; Wiltermuth & Heath, 2009), subtle facial expressions (Chartrand & Bargh, 1999; Zajonc, Adelmann, Murphy, & Niedenthal, 1987), gestures (Bavelas, Black, Lemery, & Mullett, 1987), speech patterns (Bock, 1986; Levelt & Kelter, 1982) and language accents (Howard, 1975).

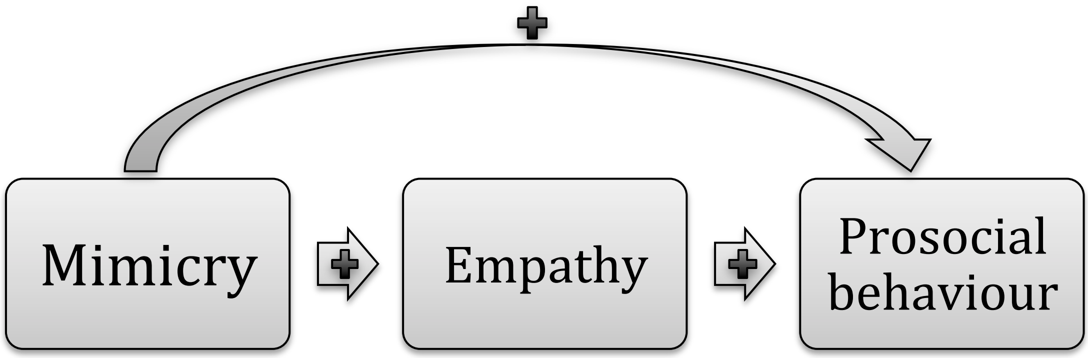
Research has also showed various positive effects of implicit imitation. Looking at the historical roots, Lakin, Jefferis, Cheng, and Chartrand (2003) argued that in the evolutionary context, it might have had a survival value. According to this assumption, humans showed very early on a fundamental need to be part of a group and those who mimicked their interaction partners were probably more accepted by a group, succeeded in building social bonding and as a result, were more likely to survive (Lakin, Jefferis, Cheng, & Chartrand, 2003). However, research on this aspect can only be done in hindsight and can provide us with mere assumptions about the role of imitation in the past. From a mere survival function, mimicking others might have developed to wider social functions: it signals general social acceptance and increases cooperation by strengthening attachment in groups (Kühn et al., 2009; Wiltermuth & Heath, 2009); it leads to and is a result of increased liking (Chartrand & Bargh, 1999; Kühn et al., 2009; Sparenberg, Topolinski, Springer, & Prinz, 2012; Stel & Vonk, 2010; Van Baaren, Horgan, Chartrand, & Dijkmans, 2004; Van Baaren, Janssen, Chartrand, & Dijksterhuis, 2009) and finally, mimicry elicits empathic feelings (Stel, Van Baaren, & Vonk, 2008; Stel & Vonk, 2009) and makes people behave in a more prosocial way (Van Baaren et al., 2004; Van Baaren et al., 2009).

Speaking of age, the Chameleon effect is not bound merely to adulthood. Studies with infants revealed that the tendency to imitate is developed very early in our lives. Even 12-, 14-, and 18-month-old infants already show a selective awareness by indicating preference for a person who imitates them (Meltzoff, 2007). In the course of individual development infants gain a better understanding of the acts of others and thus develop a self-concept by comparing their own actions with those of others (Meltzoff, 1990, 2007).

Explanatory approaches

There is no clear, fundamental explanation for the Chameleon effect. Research in social neuroscience proposes the *common coding hypothesis* or the *perception-action model* as one possible approach (Knoblich & Sebanz, 2006). Other researchers, on the other hand, present the idea that temporal contingency may elicit the positive effects; we will call this approach the *contingency hypothesis*. Both models see mimicry as an important starting point for positive effects on empathy and prosocial behaviour (for a general schematic overview see Fig. 1); however, mimicry itself is regarded in different ways.

Fig. 1. *Illustration of the Process Underlying the Chameleon Effect as Proposed by the Perception-Action Model and the Contingency Hypothesis.*



Perception-action model. The perception-action model (PAM) is based on the idea that perception and action are closely linked and can be seen as parts of one system (Prinz, 1997). When observing an action performed by someone else, the action system for the execution of this action will be activated as well. Thus, the perceptual sensory representation system and the motor representation system of the action automatically activate each other, no matter whether the observer finally performs the action or not (Knoblich & Sebanz, 2006; Prinz, 1997). Most importantly, both representation systems cannot be separated from each other. Chartrand and Bargh (1999) argue that because of this simultaneous activation, the likelihood for performing an action is getting higher after merely having observing it. The need for acting the same way arises (e.g. moving an arm), as the brain just got feedback that the arm is being moved (although it is the arm of another person) - this is how mimicking occurs, according to PAM. Berkowitz (1984) also implies that repeatedly observed actions and hence their representations can be established in the memory, which might lead to higher probability of the expression of a behavioural pattern when the stored information is re-activated (e.g. watching repeatedly violent acts on TV activates the viewer's representations of violence and automatically brings him to behave in an aggressive way) (Chartrand & Bargh, 1999).

Evidence for the perception-action link is underpinned by the idea of a mirror neuron system. So-called mirror neurons that have been found in the premotor and parietal cortex of macaque monkeys fire not only when an action is performed, but also when an action is observed (Heyes, 2010; Knoblich & Sebanz, 2006). A controversial debate among researchers discusses whether one can assign the same mirror neurons system to humans; direct evidence for such single-neurons in human brains is still missing and research is insufficient (Heyes, 2010). The perception-action model now aims to explain this correlational activation on a more superior level, concentrating more on the entire concept of activation at or prior to an action.

Dalton, Chartrand, and Finkel (2010) extended the perception-action model. They argued that people do not just mimic others continuously and without purpose, but that they consider their implicit schemas about the amount of mimicry depending on the type of social context - one selects unconsciously the appropriate schema and rate the situation. According to this theory, social interaction is always schema-driven; different social contexts activate different cognitive schemas. They argue that the perception-action model is also schema-driven and therefore not only simply an automatic overlapping process but also one that aims to foster adaptation to complex social contexts (Dalton et al., 2010).

Contingency hypothesis. Another explanatory model is the *contingency hypothesis.* According to Catmur and Heyes (2013), temporal contingency causes imitation as well and may have a similar positive effect on prosocial behavioural patterns. Contingency means an established temporal relationship between two events: temporal contingent movements are any movements that are produced right after a certain movement of the "imitatee" (a person being imitated by an imitator), no matter whether the type of movement itself actually corresponds to the initial movement or not (Catmur & Heyes, 2013).

Research to date has found evidence that five-month-old infants already prefer watching contingent actions over non-contingent actions (Bahrick & Watson, 1985; Bahrick, 1983). Bernieri et al. (1988) implied that this type of imitation is also the most natural one as it appears in everyday life and also in form of synchrony, i.e. mothers' interactions with their own children included a significantly higher amount of synchrony, but their interaction processes with unfamiliar children less so. Synchronous activity in general is part of many group activities and rituals, and has been proven to foster the development of attachment among group members and to increase cooperation (Wiltermuth & Heath, 2009). Contingency causes automatic imitation even in the absence of a direction-of-movement-overlap but mainly due to enjoyment of getting a response right after the performance of certain behaviour.

Another argument for contingency being more important for everyday life and thus more effective than congruency is that a total overlap of actions, as in congruency, may be difficult to reach, as argued by Catmur and Heyes (2013). The sensory inputs are different during the periods of (a) perception and (b) action: when observing (a) an action, one usually gets only visual input, while when performing an action (b), one can experience how it feels like to act that way and thus, proprioceptive input will be sent. Being the imitator, one can never be sure whether action *b* is really the same as action *a*, as the proprioceptive-visual response is missing. The overlap of the two sensory inputs is hard to reach, which makes it hardly possible to identify the performed actions as really similar and reach congruent actions (Bahrick & Watson, 1985; Catmur & Heyes, 2013). Congruency requires two complex computations - a visual overlap and a proprioceptive overlap - which is more difficult to reach than a mere visual overlap, that is required for contingency (Catmur & Heyes, 2013). Therefore, it may be plausible and in an adaptive sense more likely for contingency to occur more often in everyday life and therefore to affect prosocial effects, rather than complex congruency.

Empathy as an outcome of imitation

There is still a controversial discussion concerning the definition of empathy. Despite the lack of consensus among researchers, most definitions include the following aspects that we also considered in our understanding of empathy: the ability to *know* about another person's emotional state (cognitive capacity or "cognitive empathy"), to *feel* with another person and to *respond* adequately and compassionately (affective response) while being able to *differentiate* his or her perspective from one's own (monitoring mechanisms) (e.g. Batson, 2009; Lamm, Batson, & Decety, 2007; Levenson & Ruef, 1992; Preston & de Waal, 2002; Sonnby-Borgström, 2002).

The differentiation between one's own and another person's emotional state is essential in this case as its lack may lead to a confusion of empathy with other empathy-related constructs such as emotional contagion or personal distress (Decety & Lamm, 2009; Preston & de Waal, 2002). On the other hand, Preston and de Waal (2002) argue that empathy appears in different shapes (e.g. emotional contagion, sympathy, cognitive and affective empathy, identification, guilt, helping behaviour) and that all forms of empathy consist to some part of emotional contagion and personal distress. Thereby, emotional contagion is regarded to be the *affective* part of empathy (Stel et al., 2008) or "bottom-up processing" (Lamm et al., 2007) and may be distinguished from the *cognitive* part such as perspective taking.

The perception-action model (PAM) may be a suitable explanatory construct for the link between imitation and empathy. There is a lot of evidence that the bilateral connection between the sensory and the motor representation system not only takes influence on bodily movements but also on emotional states (e.g. Lamm et al., 2007; Levenson & Ruef, 1992; Preston & de Waal, 2002; Stel & Vonk, 2009). When emotions are perceived, people begin to automatically imitate these emotions by adapting their facial expressions to the perceived emotions, i.e. when someone is sad and cries, one tends to comfort this person by contracting the eyebrows and comforting him or her. At the same time, one might lean in towards them and could find tears coming to one's own eyes.

One of the explanations for the link between facial expressions, autonomic activity and emotions is called *facial feedback*. According to the facial feedback hypothesis, activated facial muscles give feedback to the brain that evokes the expression of corresponding emotions (Lamm et al., 2007; Preston & de Waal, 2002; Singer & Lamm, 2009; Stel et al., 2008; Stel & Vonk, 2009). The elicited emotions are perceived as real and proprioceptive. Given this assumption, many researchers argue that mimicry influences the process of emotional contagion, so only the affective form of empathy (Balconi & Canavesio, 2013; Hsee, Hatfield, Carlson, & Chemtob, 1990; Stel & Vonk, 2009).

Moreover, empathy can also be linked to non-facial mimicry. According to Preston and de Waal (2002) people activate their own representations of a state, whenever another person's state is perceived (not only in the face), and this turns into an automatic activation of associated somatic responses, i.e. in form of increased heart rate, modulated posture etc. However, it depends on the relationship between both interaction partners whether the emotional state is perceived and also whether the emotions are correctly identified (Preston & de Waal, 2002).

Other researchers argue that according to the PAM, imitation rather elicits the cognitive form of empathy, although it is thought to be less automatic as more time is needed to process the cognitive information (Preston et al., 2007; Stel & Vonk, 2009). This view postulates that humans usually activate their emotional representations when taking the perspective of someone else's emotional state. We acquire emotional representations over the course of our whole lives, while some always remain more active than others. When perceiving emotions of someone else, the extent to which one starts to feel empathic, depends on the extent of how the corresponding emotional representations for this state are accessible or existing at all (Preston et al., 2007).

Empathy and prosocial behaviour

Another by-product of imitation is thought to be prosocial behaviour (helping another person). Research showed that imitation makes people more helpful, thus it has effects on the behavioural level as a consequence, i.e. participants donated more money to a charity organization (Stel et al., 2008), or they changed their way to interact with others (Van Baaren et al., 2009).

Positive effects on behavioural patterns may be regarded as a result of elicited empathy. Thus, the consequence is the automatic wish to help another person. According to Stel et al. (2008), only the affective form of empathy can enhance prosocial behaviour. Certain actions may lead to empathic feelings, i.e. in form of sorrows, and therefore to the need to help. PAM suits quite well to explain this process: imitation causes an overlap of perception and action, which initiates not only the tendency to act the same way, as described above, but also, if the imitatee is in a negative emotional state, it elicits personal distress and (affective) empathy. Humans then show a tendency to minimize such personal distress by helping the other person to get out of his or her negative state - an automatic need to help or *prosocial behaviour* is elicited. It is important to keep in mind that prosocial behaviour cannot be evoked without empathy (Stel et al., 2008). Thus, we expect a higher amount of prosocial behaviour, when a higher amount of empathy is reached. More specifically, the authors propose the hypothesis that the need to act in a prosocial way occurs because the experience of an emotional overlap (shared representations) motivates the person to act in a way that corresponds these feelings. Stel et al. (2008) also argue that we can learn prosocial behavioural patterns that are building a prosocial mindset. This prosocial mindset has to be activated, so that at the time when imitation enhances empathy, both - empathy and the activated mindset - result in higher prosocial behaviour.

According to Catmur et al. (2013), however, shared representations are too complex to reach and instead, temporal contingency alone is sufficient to cause prosocial behaviour. They found out that simply being imitated right after doing an action, might influence effects on various prosocial measures which are greater liking or greater enjoyment, greater feelings of closeness to the imitator, the wish to help the experimenter by coming back to the next part of the experiment. However, one can criticize whether these measures are considered suitable for prosocial behaviour, as even the wish "to help the experimenter" is rather a vague expression of prosocial behaviour itself. Still, the authors draw the conclusion that contingency leads over the intermediate step of positive affect (greater enjoyment etc.) to prosocial attitudes in adults, as well as in children. This process may be mediated by associative mechanisms that are also involved in instrumental conditioning (Catmur & Heyes, 2013) - when certain behaviour (action A) is being linked with a contingent or non-contingent consequence, that can be a positive or negative reinforcement (action B) or a positive or negative punishment (action C); which is the process of learning stimulus-response-patterns. Hereby, the time aspect is important in order to establish the link between two follow-up actions, as it happens in the imitating process within temporal contingency - action B or C should happen very quickly after action A, so that associative mechanisms can be activated. Therefore, contingent actions versus non-contingent actions have the power to signal positive associations and to affect the expression of positive prosocial actions.

New implementations through the current study

Previous studies provide us with many examples and possible hypotheses; however, they leave us in the dark about the origins of the Chameleon effect and its outcomes - empathy and prosocial behaviour. Considering the previous findings, we aimed to gain a deeper understanding of the origins on a neural level.

Previous research on the concept of the Chameleon effect used either a naturalistic social interaction setting where the participants could interact live with a confederate or the experimenter (Dalton et al., 2010) or a minimal social context setting where they were shown videos (Leighton, Bird, Orsini, & Heyes, 2010; Stel, Van Baaren, & Vonk, 2008), imagined contact with other participants (West & Bruckmüller, 2013) or observed pictures of hands or other parts of the body doing a particular movement (Knoblich & Sebanz, 2006). Although the approach with a naturalistic social interaction includes many advantages like the ecological validity, the main disadvantage may be that many confounding variables remain uncontrolled and the final effects are not purely the result of imitation but of other factors such as individual preference or sympathy for certain characteristics (McGuigan, 2013; Stel & Vonk, 2009; Van Baaren, Janssen, Chartrand, & Dijksterhuis, 2009; Yabar, Johnston, Miles, & Peace, 2006).

We already got a great overview of the functioning of the Chameleon effect, however some information is still missing. Studies that combine various imitation conditions, as well as a control condition, are still missing. We found that it is therefore important to create a study design where we get information about the individual's reactions to (a) movement congruency vs. no imitation and to (b) temporal contingency vs. no imitation. As for research on contingency, there are not enough studies with adults; usually, they were conducted with children (see Bahrick & Watson, 1985; Bahrick, 1983). Furthermore, there is a lack on controlled but naturalistic scientific approaches - it is pivotal to create a new study design, which has a high reality factor for the participants (e.g. they are not asked to imagine the emotional state of others but do it unconsciously as they experience the same procedure) that can be repeated, too. There are also not enough studies combining first only an imitation procedure, then link it to real experiences of empathy and explicit prosocial behaviour. Psychophysiological methods, such as facial electromyography, have not yet been used in combination with research on imitation and empathy.

With these considerations in mind, we aimed to create a naturalistic social interaction setting on the one hand, but also control for confounding variables such as differences in movements between two individuals, initial sympathy or preference on the other hand. To reach this, we made the participants believe that they are playing a game with two other co-players but we did not tell any details about them (e.g. sex, age etc.); we showed videos of the co-players to maximize the reality factor, but their faces were not visible, only the upper body without the head. In order to standardize the appearance as well as to give the opportunity to differentiate the two co-players from each other, everyone was wearing a different coloured lab coat; no reactions were shown and no sounds were heard. We also emphasized at the beginning of the experiment that all results and the testing procedure will remain anonymous and the participants would not meet the other co-players.

The current knowledge and the missing information led us to the following research questions are: does implicit imitation by person A compared to person B (who does not imitate) increase later empathy for this person A? Does implicit imitation lead to an increase in the prosocial attitude towards person A? Are such effects of imitation on prosocial behaviour mediated by increases in empathy?

We conducted a within-group study design with two experimental groups, each with an *imitation* and a *control condition* (appeared during the first part of the experiment), as well as with different *pain conditions* (appeared during the second part). The imitation conditions in group 1 were "*movement congruency"/"random movements"*, the pain conditions were "*self pain*"/"*non-painful shocks*"/"*painful shocks*"; group 2 included the imitation condition "*temporal contingency*"/*"random movements"* and the same pain conditions ("*self pain*"/"*non-painful shocks*"/"*painful shocks"*).

Increase of empathy due to imitation. First, we asked ourselves whether implicit imitation by person A compared to person B (who does not imitate) would later increase empathy for person A. We thus aimed to create a control condition within each group in order to be able to compare the reactions towards each of the two persons. Afterwards, we let the participants experience pain and observe both co-players experiencing it as well. The amount of empathy was assessed with behavioural ratings on the one hand ("empathy ratings") as well as "affiliation ratings" that were supposed to give additional information about the amount of affiliation (see section "method"), and with psychophysiological measures on the other hand.

We decided to make use of painful electrical stimulation in order to induce an empathic state. According to the perception-action model, humans use their own representations to understand other persons (Preston & de Waal, 2002). Therefore, it was essential to let the participants experience painful stimulation on their own, so that they would be able to comprehend the emotional states of others. Using pain in order to induce empathy is a common and successful procedure in current social neuroscience (e.g. Gerdes, Wieser, Alpers, Strack, & Pauli, 2012; Jackson, Meltzoff, & Decety, 2005; Singer et al., 2004) mostly because pain triggers negative feelings and evokes an aversive affective state (Lamm et al., 2007). Observing another person in pain automatically activates the autonomic nervous system, and as a result it is possible to measure differences of somatic activations with psychophysiological methods. For example, the low-level mechanisms contributing to empathy can be assessed with facial electromyography (Singer & Lamm, 2009) and the skin conductance response, for instance.

Empathy reflected by autonomic nervous system activations. Emotions contain various conscious and subconscious components. One can measure visible emotional components with questionnaires, ratings, and observation of the person's facial mimic, postures, gross motor behaviour etc. These methods are mostly used to measure conscious emotional states. Unconscious emotions are more difficult to assess. Bearing this in mind, we found it important to make use of psychophysiological methods in addition to explicit self-reports, because it provided us with information about these subconscious emotional components. We therefore intended to measure the differences in the autonomic nervous system's activity that underlie facial expressions, with the technique of facial electromyography (fEMG).

Facial muscle reactions are assumed to be linked to emotional empathy and they are expected to start very early, after a short exposure time (Sonnby-Borgström, 2002). It is suggested that such affective reactions are elicited even before the person has consciously processed the information. For this reason we chose to use fEMG recordings as a measure of empathy. fEMG is also a useful tool because we expected the facial muscle reactions to be very weak and hardly detectable by mere observation (Huang, Chen, & Chung, 2005; Sonnby-Borgström, 2002). According to the literature, neural activations in the brain are displayed in somatic and autonomic responses (De Coster, Verschuere, Goubert, Tsakiris, & Brass, 2013), and we can therefore assume that any somatic and autonomic responses are due to changes in neural activations and display empathic responses.

We decided to record activations within the *M. corrugator supercilii* and *M. orbicularis oculi* as activations in these regions are understood to reflect aversive emotional states (Blumenthal et al., 2005; Gerdes et al., 2012; Jäncke, Vogt, Musial, Lutz, & Kalveram, 1996; Lang, Bradley, & Cuthbert, 1990; Sonnby-Borgström, 2002; Yartz & Hawk, 2002). Given the fact that our manipulation was intended to put the participants into an aversive state when watching other persons receiving painful electrical stimulation, we decided to measure empathy respectively. The *M. orbicularis oculi* was to provide us with a measure of the startle reflex which is a rapid eye blink reflex due to sudden, frightening stimuli and is understood to be an index for negative emotions (Blumenthal et al., 2005; De Coster et al., 2013; Lang et al., 1990; Yartz & Hawk, 2002). It has been shown that the amplitudes of the startle reflex are higher in negative situations and since observing another person in pain has a negative value, it may be an adequate measurement for our manipulation (De Coster et al., 2013). The *M. corrugator supercilii* is understood to reflect annoyance (Jäncke et al., 1996), disgust (Wolf et al., 2005), a slowdown in the processing of incongruent information (Gerdes et al., 2012), and generally unpleasant emotional states (Lang et al., 1990; Yartz & Hawk, 2002).

Many studies have shown that electrodermal activity (EDA) is also applicable to assessment of emotional states. Changes in skin conductance are responses of the sympathic nervous system and have been widely proven to be a concomitant of emotional arousal (Benedek & Kaernbach, 2010a, 2010b). Therefore, we assumed that measuring EDA might lead us to additional information concerning aversive emotional states and empathy.

The first hypothesis of our study is therefore an increase of empathy for the congruent/contingent person relative to the random person (H1). This increase should be demonstrated in overall higher activation of facial musculature while observing the videos where the imitating person in both groups receives painful stimulation. More precisely, the muscle group around the *corrugator supercilii* and around the *orbicularis oculi* should display a higher activation. We expected a higher startle response for the congruent/contingent person relative to the random person during painful stimulation. Apart from the psychophysiological results, we expected to see this increase of empathy in self-reported ratings (empathy and affiliation ratings).

Increase of prosocial behaviour due to imitation. The second research question in our study was whether imitation leads to an increase in the prosocial attitude towards person A. Our deliberation was to find out more about these effects in the course of the third part of the experiment, where the participants were forced to favour one person above the other in their prosocial behaviour; in the course of the "prosocial task" participants had to decide whether they were willing to take over shocks from the other players, being the prosocial decision, or whether they would like to pass on some of their shocks that they were supposed to get afterwards to others, being the egoistic option. We presented them with a forced-choice task in order to avoid inequity aversion by individuals who might refuse to give more shocks to one person than to another one.

The second hypothesis contained the assumption that the participants favour the congruent/contingent person over the random person in decisions concerning on whose behalf they would take the painful stimulation – (H2). We expected a clear tendency towards the congruent/contingent person in the behavioural responses as an effect of the imitation priming. The behavioural responses provided with this task should replicate the results of previous research that has shown that imitation fosters prosocial behaviour (Lakin et al., 2003; Van Baaren et al., 2009).

We also asked ourselves whether such expected effects of imitation on prosocial behaviour might be mediated by increases in empathy that one could see already before any prosocial or egoistic behaviour is shown - (H3). Previous research has shown that imitation seems to have effects on prosocial behaviour but no explanations for this outcome have been derived yet (e.g. Stel et al., 2008; Van Baaren et al., 2009). Our assumption was that if both outcomes - empathy and prosocial behaviour - are the result of common representations, they should be reflected by empathy ratings as well as autonomic nervous system activations at a very early stage, maybe even before the individual realizes how he or she will ultimately act in the end.

Movement congruency or temporal contingency? As already mentioned, we are interested in finding out what kind of process underlies the Chameleon effect. The first proposed hypothesis is the perception-action model. The mechanism of this model leads us to the assumption that it is important to control for two components while studying motor imitation: direction of the movement and time of performance. According to the perception-action model, imitation has to be exact in terms of direction and time, so that the overlap of action and perception can take place and lead to the positive outcomes. We therefore examined the influence of movement congruency within group 1 in our study with the question whether a time overlap as well as a direction overlap is required.

Second, the contingency hypothesis was analysed within group 2. We tested whether an overlap of time of performance alone is sufficient for the positive effects. An overlap in time alone means that as soon as the participant performs a movement, the imitating co-player would move the joystick as well, but if the participant would not move it, the co-player would remain motionless as well. In terms of contingent imitation, any prompt response to the performed movement counts, the exact overlap of the kind of movement does not matter. We assumed that should we find any prosocial and/or empathic effects in this condition, a possible explanation might be that the prosocial tendencies are due to other processes than automatic mimicry. It could be possible that participants simply enjoy the responsiveness they cause with their actions and as a consequence they are more motivated to act in a prosocial way. More precisely, they get a reaction from another person and therefore they realize that they have an influence on the environment, which turns into a feeling of *personal effectance* that can be generalized (Bigelow & Birch, 1999) - if the person who responded to their actions is in danger, they would help her.

Finally, the fourth hypothesis of our study was therefore distinguishing movement congruency from temporal contingency effects: temporal contingency was assumed to have no influence on empathy and prosocial behaviour - (H4).

METHOD

Participants

A total of 73 participants took part in the study. Exclusion criteria were study in the field of psychology; an age of over 40 years; psychiatric and neurological disorders, especially tinnitus and motor tics; the reasons for the latter exclusion criteria are first, that exposure of individuals with tinnitus to loud acoustic sounds is not ethically correct and they may not show the same surprising reaction to the sounds, second, motor tics would interfere with electromyographic recordings. Due to these criteria or other problems (i.e. pain stimulator did not deliver any pain; painful stimulation was not noticeable or decreased over time; one participant showed text comprehension difficulties; one participant could not sit up straight) nine participants were excluded during the testing period. The final sample consisted of 32 participants in each group (Group 1: 14 men, 18 women, age range 19-37 years, $M_{Group1} = 24.84$, $SD_{Group1} = 4.03$; Group 2: 14 men, 18 women, age range 18-38 years, $M_{Group2} = 25.34$, $SD_{Group2} = 5.21$). The recruitment was conducted via an advert on the internet job search engine Jobwohnen.at and from the participants' list of the Social, Cognitive and Affective Neuroscience Unit (SCAN-Unit) of the Faculty of Psychology in Vienna.

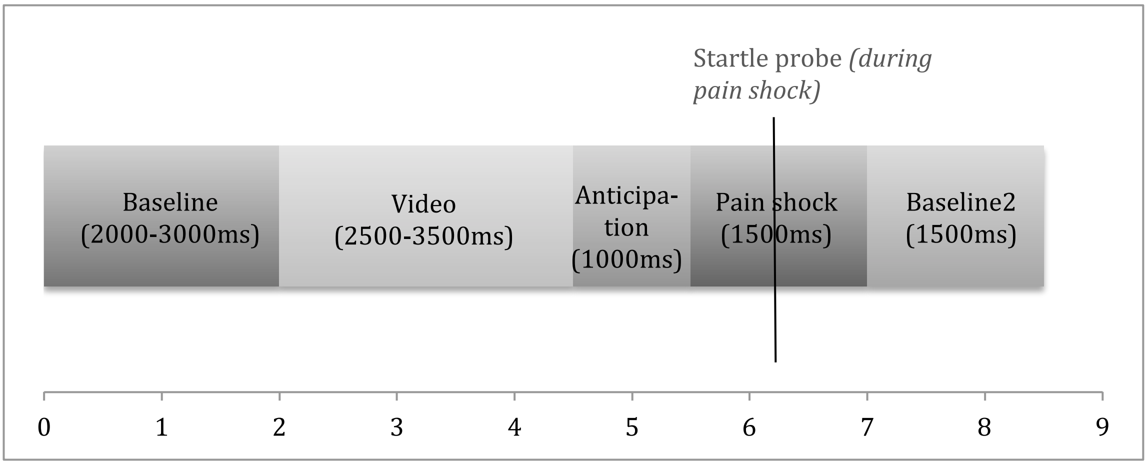
Procedure

Upon arrival, participants were told that they were to take part in an interactive online computer game where they would play with two other persons whom they would not meet during the experiment but would see via a live webcam connection. The experimenter emphasized that anonymity was guaranteed, as the webcam would only show their arms and shoulders. This is important, as previous research has shown that knowledge of certain attributes such as status or level of dominance or age of other participants might influence the imitation behaviour (McGuigan, 2013). We aimed to limit the influencing variables to only movement imitation. The co-players did not exist for real, however; we only showed videos of formerly recorded persons.

Participants were seated in front of a screen (at approximately 1 meter distance). The experiment started with the joystick task (duration: 25 minutes) where we induced imitation priming. In the beginning and at the end of each task an instruction appeared on the screen. The instruction was to move the joystick to the right or left direction following a "GO" signal or not to move it all; if there was no movement within 3 seconds, then the next trial started. After the participant has conducted a movement (or the 3 seconds passed without any movement), a short notification appeared whose turn is next and a video of another co-player was displayed how she is moving the joystick (duration: 2.5 - 3 seconds). The order of videos was randomized. This task consisted of 120 trials.

Then the experimenter prepared the participants for the following empathy task. The preparation included attaching the electrodes for the measurement of fEMG and the skin conductance response. Another electrode was attached to the participant's right hand, through which he or she would get electrical stimulation. The strength of the stimulation was calibrated individually with the aim of finding a lower level of stimulation ("non-painful shock" = noticeable but not painful at all) and an upper level ("painful shock" = painful but endurable over a longer time). Prior to pain delivery, we showed a picture of the co-player who will receive the pain next, and we also showed a colourful flash, depending on the pain condition (blue flash = non-pain trial, orange flash = pain trial), in front of the person that should indicate the coming pain stimulation. This was the anticipation sequence. During the pain delivery sequence another colourful flash appeared and indicated the pain delivery (green flash = non-pain trial, red flash = pain delivery). The flashes were in different colours (two for pain trials, two for non-pain trials). During the empathy task, the participants completed four blocks (two pain blocks and two non-pain blocks) where either they themselves or the co-players received electrical stimulation; the order was randomized within all blocks. Each block consisted of 18 trials in randomized order (six self-pain trials, six congruent or contingent trials, six random trials). Half of the trials in each block (nine trials) were combined with a startle stimulus that was a sudden, short, loud noise of 104 dB that appeared 1.000ms after the delivery of an electrical stimulation via headphones; the duration was 50ms. In order to familiarize the participants with the noise, the startle stimulus was presented five times at the start of the experiment. After each block "empathy ratings" were presented, where the participants were asked to answer some questions concerning experienced empathy by rating on a 7-point Likert scale. At the end of the empathy task the participants had completed 72 trials (total duration: 30 minutes); an example trial is shown in Fig. 2. There was an inter-trial interval (ITI) of 17 seconds.

Fig. 2. *Example of a Trial From the Empathy Task. The Duration of the Videos Varied Randomly. The Baseline Was Counted From the Event of Anticipation and Thus Varied in the Length, Depending on the Duration of the Video.*



The experiment ended with a prosocial task (duration: 5 minutes) where the participants initially played a gambling game against the other co-players. Prior to the game they were told that everyone would receive up to 12 shocks at the end of this task. The number of shocks would depend on the number of rounds every player has won - every round can bring a deduction of the final amount of shocks. Our participants always won however, which was the default setting: they were supposed to receive 6 instead of 12 shocks and each of the other co-players - 10 shocks. Afterwards, they were presented a forced choice mode: they were firstly asked to decide whether they were willing to take over shocks from the other players (prosocial option) or whether they wanted to pass on some of their shocks (egoistic option) and secondly, which co-player was favoured in the unequal re-distribution of the shocks. There was no option to let everyone simply get their shocks and pass on with the experiment. Here, we aimed to assess a preference for one of the two co-players and subsequently see if the participants would behave in a prosocial or egoistic way.

Following the last task, participants were asked to answer questions regarding the extent of perceived affiliation by rating on a 7-point Likert scale, which were the "affiliation ratings", and to complete a debriefing questionnaire where they had to guess the purpose of the experiment, estimate the strength of electrical stimuli, and explain their preference for a certain co-player etc. All participants received a reward of 15€ after successful participation in the experiment.

Design

The study employed a within-subject quasi-experimental design with two experimental groups, each with an imitation condition and a control condition. The design refers to the first part of our study, namely the "joystick task" where the participants had to move a joystick and watch two other co-players doing the same. Meanwhile one of the co-players was imitating the joystick movements of the participants; the other co-player was just randomly moving it. The two imitation conditions were the following:

(1) *Movement congruency imitation:* A congruence between performed movements in the majority of all trials was established (in 80% of the trials movement to the same direction). In group 1, the imitating co-player behaved in a congruent way – there was an overlap of time of performance and direction, i.e. the participant moved the joystick to the right, then co-player A responded with a movement and also moved the joystick to the right. Not only the direction was important but the fact that the movement was made at all.

(2) *Temporal contingency imitation:* Only the time of performance was modulated in this condition (in 80% of the trials movement at the same time). In group 2, the imitating co-player moved the joystick in a contingent way – there was an overlap of time of performance with the participant; the direction did not matter anymore, i.e. when the participant moved the joystick, the co-player A moved the joystick as well. When the participant did not move the joystick, the co-player did not move it either. The direction was in 50% of the trials the same, in 50% - not.

Each group included also a *control condition*: a second co-player, the "random player", who always behaved randomly: she moved the joystick in 50% of the trials to the same direction as the participant and in the other 50% - to another direction. In group 2 the random player moved the joystick in 50% of the trials but she did not move it in the other 50%.

Participants were assigned to one of two groups by the study instructor (the first 32 participants were assigned to the first group, the following 32 to the second group), whereas the computer program randomly assigned the order of conditions within the experiment and which co-player with what lab coat colour had the role of the imitating player in the experiment.

The independent variables were *painfulness* ((a) non-painful shock, (b) painful shock) that was applied in the "empathy task" and *imitation condition* that was applied in the "imitation task" ((a) self, (b) congruent in group 1/contingent in group 2, (c) random). The dependent variables were *empathy* and *prosocial behaviour*.

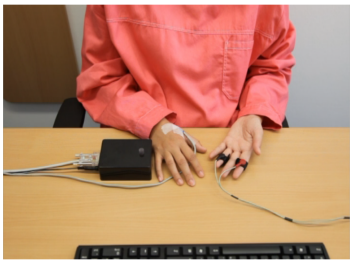
Materials

A webcam was placed on the top of the computer screen in the testing room to simulate real Skype video connections with the other co-players. Instead of a live webcam connection, videos of two female persons that were recorded in advance were shown. Only the upper body, including arms but no head were filmed. During electrical stimulation, no reactions in form of movements (like shrugging) or any sound were shown or heard (see Fig. 3).

Fig. 3. *Snapshots of Presented Videos. Fig. A Shows a Co-Player During the Joystick Task. Fig. B Shows a Co-Player During the Empathy Task.*

A

B



All participants were given a yellow or green lab coat that had to be worn reversed. Co-players in the videos were wearing red and blue lab coats. It was randomized whether the imitating co-player or the randomly behaving co-player was red or blue, in order to avoid a colour preference effect.

Psychophysiological measures

Facial electromyographic (EMG) activity in the corrugator supercilii and orbicularis oculi muscle group regions was registered. The electrodes were placed using the guidelines of Fridlund and Cacioppo (1986) as well as Blumenthal et al. (2005) for the registration of the startle eye blink reflex. Two Ag/AgCL electrodes (4 mm) were placed on the left side of the face, over the M. corrugator supercilii, and two Ag/AgCL electrodes (4 mm) for the M. orbicularis oculi were placed on the right side, below the right eye. A ground electrode was placed over the right mastoid. Signals were registered with a TMS International Portilab 20 channel amplifier (www.tmsi.com, Netherlands, sampling frequency: 2,048 Hz).

The raw signal was amplified, low-pass filtered (filter: 800 Hz), high-pass filtered (filter: 26 Hz) and notch filtered (filter: 50 Hz), rectified and smoothed. All trials were visually inspected and artefacts (i.e. due to movements) were removed. Data processing was performed with Matlab 7.1 (MathWorks Inc., USA) using the EEGLAB 9_0_4_6s toolbox (Delorme & Makeig, 2004) and IBM SPSS Statistics 22 package.

Furthermore, we measured EDA activity with two electrodes placed on the middle and ring finger of left hand. The results will however not be reported in this paper.

Behavioural measures

Empathy ratings. After each block of the empathy task participants were asked questions concerning their impressions and experienced empathy. Answers had to be rated on a Likert scale (1 to 7). The items related to the perceived amount of the following variables: a) *painfulness,* either for themselves or for the co-player - "Wie schmerzhaft waren die eigenen Stimulationsreize?" / "Wie schmerzhaft waren die Stimulationsreize für die Person?", b) *unpleasantness* for themselves - “Wie unangenehm war es für Sie, die Stimulationsreize mitzufühlen?”, c) *distress* - “Wie belastet fühlten Sie sich während die Person die Stimulationsreize erhielt?”/ “Wie belastet fühlten Sie sich während der eigenen Stimulationsreize?” d) *compassion* - “Wie mitfühlend fühlten Sie sich während die Person die Stimulationsreize erhielt?”.

Affiliation ratings. At the end of the experiment, questions concerning affiliative feelings were presented. Again a Likert scale (1 to 7) was used. Items concerned the amount of perceived *sympathy* - "Wie sympathisch kommt Ihnen diese Person vor?", *cooperation* - "Wie entgegenkommend kommt Ihnen diese Person vor?", *familiarity* - "Wie vertraut kommt Ihnen diese Person vor?", *similarity* - "Wie ähnlich zu Ihnen selbst kommt Ihnen diese Person vor?", *connectedness* - "Wie verbunden fühlen Sie sich mit dieser Person?".

RESULTS

Behavioural measures

In order to get an overview over general explicit behaviour, we took a closer look at answers of all 32 participants within group 1 and group 2. No one has been excluded.

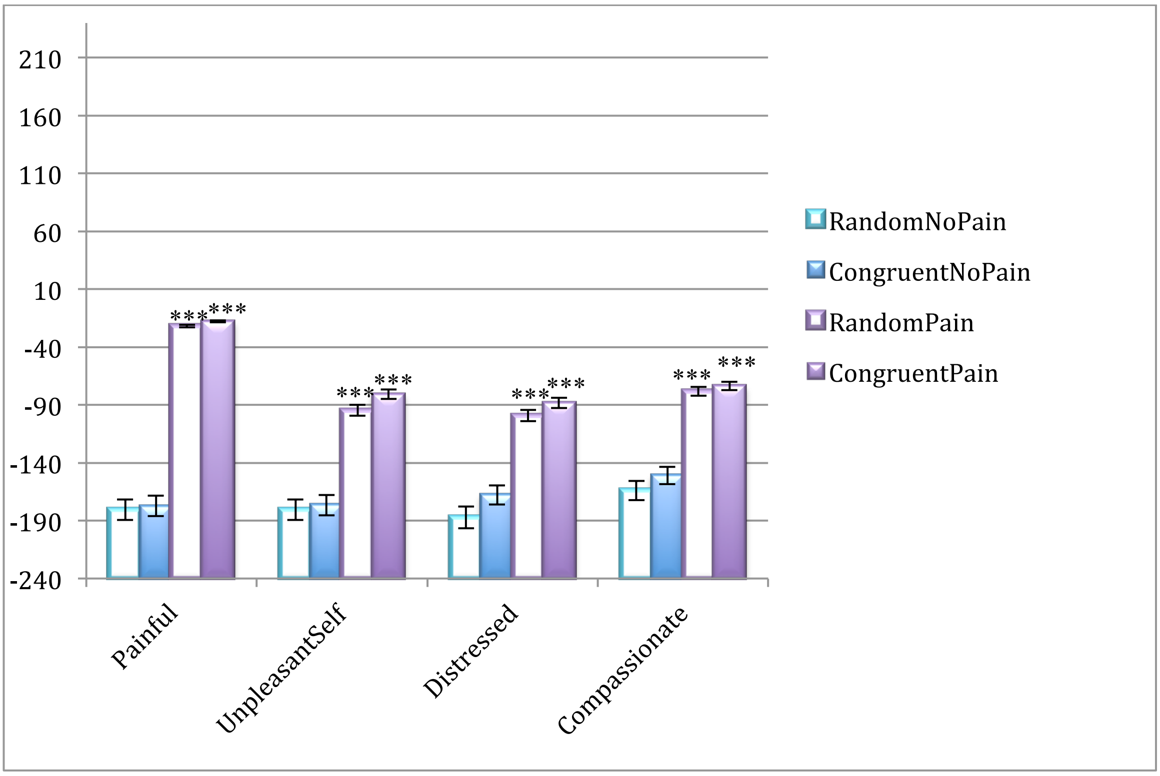
GROUP 1 (Movement Congruency Condition)

Debriefing questionnaire. 20 out of 32 participants mentioned having had no or some doubts concerning the existence of the other co-players; they trusted the story told by the experimenter. 12 participants had strong doubts or were sure the co-players were not real. However, there is no predominant majority of believers vs. non-believers that is significant ($\chi^2(1) = 2$, $p = .157$). 18 participants stated having noticed that they were being imitated during the joystick task. 14 participants did not notice the imitation ($\chi^2(1) = .5$, $p = .480$). 15 participants had the impression that the other co-players reacted to their movements; while 17 participants did not have this impression ($\chi^2(1) = .13$, $p = .724$). 15 participants experienced the empathy rating task as easy; 17 of 32 found it rather difficult ($\chi^2(1) = .13$, $p = .724$). Neither one of these statements turned out be of greater importance for further analysis, as the results were not significant.

Empathy ratings. As shown in Figure 4, means of empathy ratings were computed for congruent pain, congruent non-pain, random pain, and random non-pain conditions.

First of all, a manipulation test was conducted in order to see whether the participants experienced higher amounts of empathy during pain trials in comparison to non-pain trials. Friedman's ANOVA revealed that there was a highly significant differentiation between pain and non-pain trials within the congruent condition ($\chi^2(7) = 77.19$, $p < .001$) as well as within the random condition ($\chi^2(7) = 109.93$, $p < .001$). Further analysis with pairwise Wilcoxon tests confirmed that participants rated pain congruent trials in comparison to non-pain congruent trials as more *painful* (z = -4.60, $p = < .001$), more *unpleasant* for themselves (z = -4.20, $p < .001$), they were more *distressed* (z = -3.48, $p < .001$), as well as more *compassionate* (z = -3.78, $p < .001$). The same effect happened when the random co-payer received painful shocks: the shocks were experienced as more *painful* than for the non-pain random condition (z = -4.84, $p < .001$), more *unpleasant* for the observer (z = -4., $p < .001$), made participants more *distressed* (z = -4.04, $p < .001$) and more *compassionate* (z = -4.17, $p < .001$).

Fig. 4. *Manipulation Test of Empathy Ratings, Divided Into Pain and Imitation Conditions. Rating Scale Range: -240 (low) - 240 (high). Pairwise Wilcoxon Tests Were Conducted with A) Pain Congruent vs. Non-Pain Congruent, B) Pain Random vs. Non-Pain Random. Pain-Trials Were Significant With Regard to the Following Variables (See X-Axis).*



Note. n = 32. ***$p < .001$ based on Wilcoxon Signed Ranks Test.

To test for the hypothesis (H1) whether there was an increase of empathy due to movement congruency, we conducted Wilcoxon signed-ranks tests with pairwise comparisons of congruent and random trials (empathy ratings), respectively. Participants did not show a difference between those two conditions: neither one was experienced as more *painful*, z = -.17, $p = .864$, nor more *unpleasant*, z = -1.632, $p = .103$, nor more *distressing*, z = -1.142, $p = .254$, or made them feel more *compassionate*, z = -.415, $p = .678$.

Affiliation ratings. The affiliation ratings were analysed with Friedman's ANOVA and pairwise Wilcoxon tests to see if there are any effects when it comes to affiliation, which was assessed independently from the empathy task. Here, we found a clear trend (see Tab. 1) towards higher affiliation with the congruent person, more than with the random person. As shown in Table 1, the trend was reflected by a significantly higher *connectivity* with the congruent person (z = -2.44, p <.05), higher experienced *familiarity* (z = -1.96, p = .05) and more *sympathy* (z = -1.93, p = .053).

Table 1. *Means (Standard Deviations) of Affiliation Ratings, Divided Into Imitation Conditions. Rating Scale Range: -240 (low) - 240 (high).*

Imitation condition	Affiliation rating variable				
	Sympathy	Cooperation	Familiarity	Similarity	Connectivity
C	**31.25**$^{+}$ (116.42)	-28.44 (120.59)	**-88.44**$^{+}$ (125.83)	-49.38 (139.61)	**-44.69*** (158.15)
R	-9.69 (111.37)	-31.56 (107.17)	-126.88 (99.14)	-69.38 (132.86)	-116.88 (115.24)

Note. C = Congruent, R = Random. n = 32.

^{+}p< .10, $^{*}p$< .05 based on Wilcoxon Signed Ranks Test.

Prosocial behaviour. After being exposed to a forced-choice question about whom to help (also: "help choice"), during the prosocial task, 23 out of 32 participants chose the congruent player, whereas nine participants chose the random player. This result shows a strong preference towards the co-player who had the imitating role ($\chi^2(1) = 6.13, p < .05$). Furthermore, 20 participants decided to help one of the co-players by taking some of the pain shocks on his or her behalf - we define this behaviour as *prosocial*; whilst 12 participants preferred not to help, but give some of their own shocks to the others - *egoistic* behaviour.

We then examined whether it would be possible to predict the choice of whom to help as well as the prosocial behaviour by looking at the responses of empathy or affiliation ratings. A binary logistic regression revealed that although 78.1% of the help choice could be predicted correctly by the empathy ratings, they are not sufficient to be able to predict the help choice ($\chi^2(4) = 2.90, p = .575$).

The same applies to affiliation ratings: 78.1% of the help choice is correctly predicted by affiliation ratings, but they do not constantly predict the help choice ($\chi^2(5) = 3.45, p = .631$).

It also cannot be predicted how people will behave - in a prosocial or egoistic way - only by looking at empathy ratings across conditions ($\chi^2(4) = 6.74, p = .15$).

GROUP 2 (Temporal Contingency Condition)

Empathy ratings, affiliation ratings and prosocial behaviour. The behavioural ratings of group 2 were neither significantly different between conditions, nor did they show any specific trend. Participants did not report any preference towards one or other of the co-players (17 participants chose the contingent person, 15 chose the random person; $\chi^2(1) = .13$, $p = .724$) and they did not rate the shocks of either one of the two co-players as differently *painful* ($z = -.80$, $p = .422$), *unpleasant* (z = -.90, $p = .367$), *distressing* (z = -.57, $p = .567$) and they did not feel differently *compassionate* (z = -.23, $p = .819$). They also did not experience any significant changes in the amount of *sympathy* ($z = -.22$, $p = .829$), *cooperation* ($z = -.61$, $p = .542$), *familiarity* ($z = -.72$, $p = .475$), *similarity* ($z = -.57$, $p = .569$) or *connectivity* ($z = -.19$, $p = .846$) towards one of the co-players.

Due to time constraints, physiological data for group 2 will not be discussed in this paper.

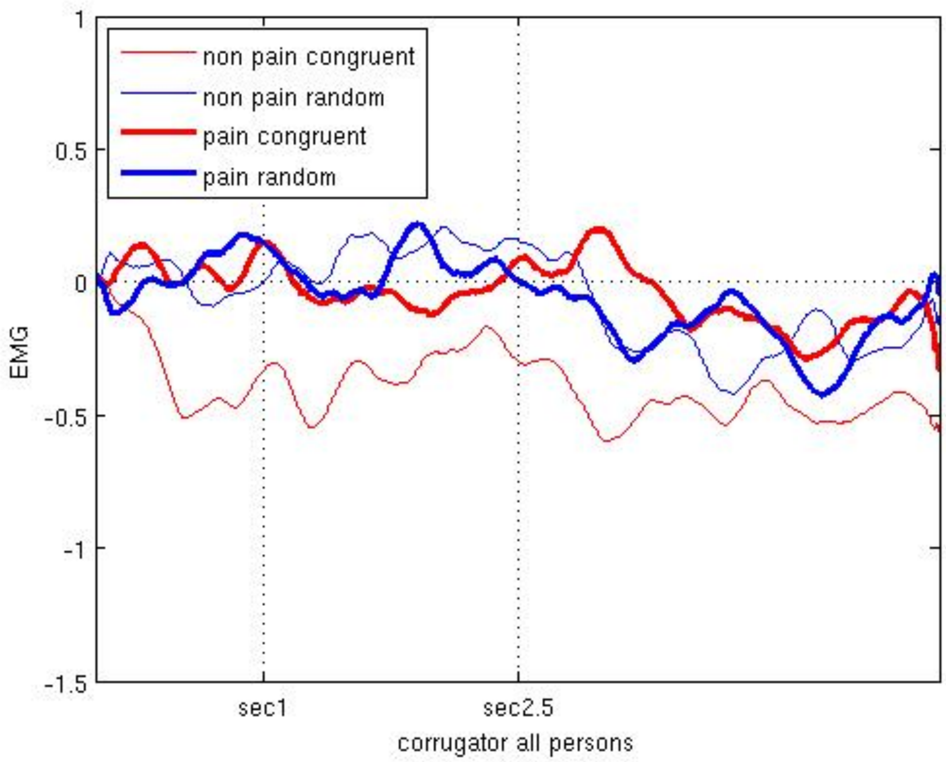
Facial EMG measures - GROUP 1

To test whether participants also showed a differential empathic reaction in form of psychophysiological arousal, we analysed the data separately for each muscle side. Due to technical problems or a high amount of movement artefacts, five participants had to be excluded during the analysis of the M. corrugator (final sample: $n = 27$) and three participants during the M. orbicularis analysis (final sample: $n = 29$). All condition combinations were analysed, apart from the self-pain condition, as it was not the intention of the study to find out more about individual reactions to pain.

M. corrugator supercilii. The final data of the M. corrugator contained raw and z-transformed data, averaged over a 1,000ms-interval (entire anticipation sequence), a 1,500ms-interval (entire pain shock sequence) and several smaller 500ms-intervals in relation to a 2,000-3,000ms-baseline prior to the video sequence. The baseline was added afterwards during the pre-processing.

We analysed facial electromyographic activation of the *anticipation* sequences and the *pain shock* sequences, but only those without a startle tone. A 2 (pain conditions: pain, no-pain) x 2 (imitation conditions: congruent, random) x 7 (time intervals: 0-1,000ms, 1,000-2,500ms, 0-500ms, 500-1,000ms, 1,000-1,500ms, 1,500-2,000ms, 2,000-2,500ms) repeated-measures ANOVA with raw data revealed a significant effect for the different time intervals ($F(6, 156) = 2.51$, $p < .05$, $\eta_p^2 = .09$). We thus can assume that different activation took place over time. Different *imitation conditions* seem to have a slight effect on overall activation, as one can see a trend that implies their influence ($F(1, 26) = 3.19$, $p = .086$, $\eta_p^2 = .11$). The trend is towards a higher activation in the congruent condition. However, the *time intervals* and *imitation condition* seem not to have interacted with each other ($F(6, 156) = 1.17$, $p = .326$, $\eta_p^2 = .04$). An interaction of *pain conditions*, *imitation conditions* and *time intervals* did not appear either ($F(6, 156) = .18$, $p = .983$, $\eta_p^2 = .01$). All activation curves over time can be seen in Fig. 5.

Fig. 5. *Averaged M. Corrugator Response Curves Over Time During the Empathy Task. For Better Comparison, All Electromyographic Responses Were Merged To the Starting Point of 0µV. The Vertical "EMG" Scale Represents Standardized Mean µV Change.*



As a follow-up, separate ANOVAs for each time interval were performed. Surprisingly, only one time interval, namely 500-1,000ms which is the second half of the anticipation, included a significant main effect of the *imitation condition* ($F(1, 26) = 5.61$, $p < .05$, $\eta_p^2 = .18$), but no significant influence of pain. This does not correlate with our initial hypothesis as we expected to see significant effects in both anticipation and pain shock sequences. As can be seen in Fig. 2 the activation in the non-pain congruent condition is the lowest at that point ($M_{NonPain\_Cong}$ = -.44, $SD_{NonPain\_Cong}$ = 1.24) and gradually decreases. Furthermore, it seems that as soon as the congruent co-player received a non-pain shock, the activation of the M. corrugator remained in the negative µV-area ($M_{NonPain\_Cong}$ = -.33, $SD_{NonPain\_Cong}$ = .99), while it became more positive when observing the congruent co-player receiving a pain shock (M_{Pain_Cong} = .12, SD_{Pain_Cong} = .89), or a random player receiving a pain shock (M_{Pain_Rand} = .05, SD_{Pain_Rand} = .66). This differentiation in the activation can be observed in the trend towards an influence of the *pain conditions* ($F(1, 26) = 3.72$, $p = .065$, $\eta_p^2 = .13$) in the 1,000-1,500ms-time interval. However, no other significant influences could have been found for any variables across all conditions and over all time intervals (all *F*s < 5.8, all *p*s > .10).

In the course of post-hoc analyses, we examined the influence of *prosocial behaviour* as a variable to see if we can find any difference in the activation when we look only at participants who behaved in a prosocial way versus participants who behaved in an egoistic way. *Prosocial behaviour* did not appear to be a significant variable ($F(1, 25) = 1.35$, $p = .256$, $\eta_p^2 = .05$). However, when splitting the data into two groups (prosocial participants: n = 16; egoistic participants: n = 11), a repeated-measures ANOVA indicated significant effects within the prosocial group: it made a difference whether these participants observed the congruent or random co-players receiving pain - a trend towards the congruent condition became apparent: $F(1, 15) = 4.14$, $p = .06$, $\eta_p^2 = .22$. Besides, as expected, they experienced significantly different contractions of the M. corrugator over time ($F(6, 90) = 3.78$, $p < .01$, $\eta_p^2 = .20$). Similar to the follow-up ANOVA of the entire group 1, an ANOVA for single time intervals revealed almost significant effects in only one time interval: 500-1,000ms ($F(1, 15) = 4.47$, $p = .052$, $\eta_p^2 = .20$). The activation pattern of prosocial participants has also higher variance (see Fig. 6a).

In contrast, the egoistic group did not show such a characteristic development over time, $F(6, 60) = .75$ $p = .998$, $\eta_p^2 = .01$, (see Fig. 6b).

Fig. 6a. *Averaged M. Corrugator Response Curves Over Time During the Empathy Task of Only the Prosocial Group.*

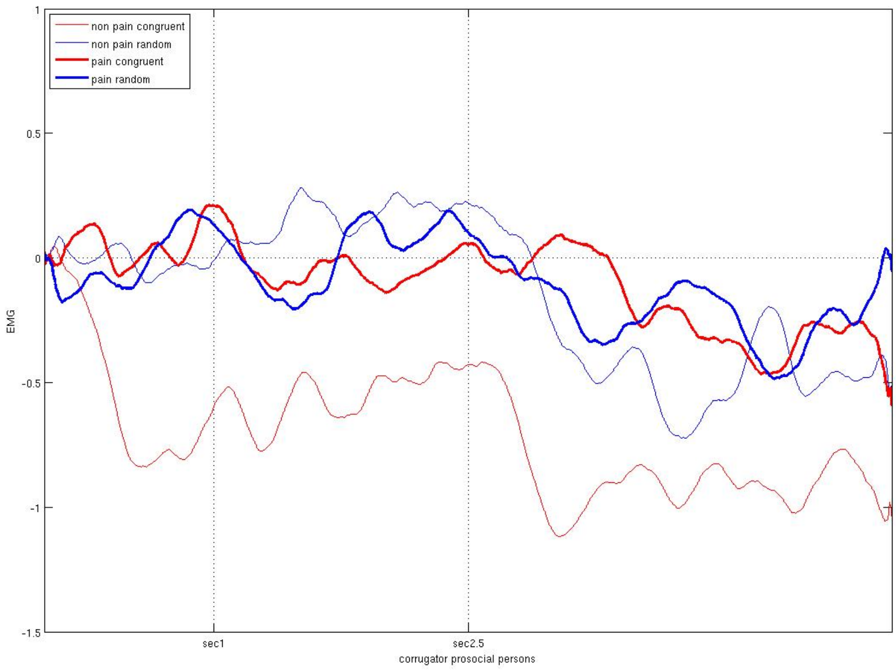
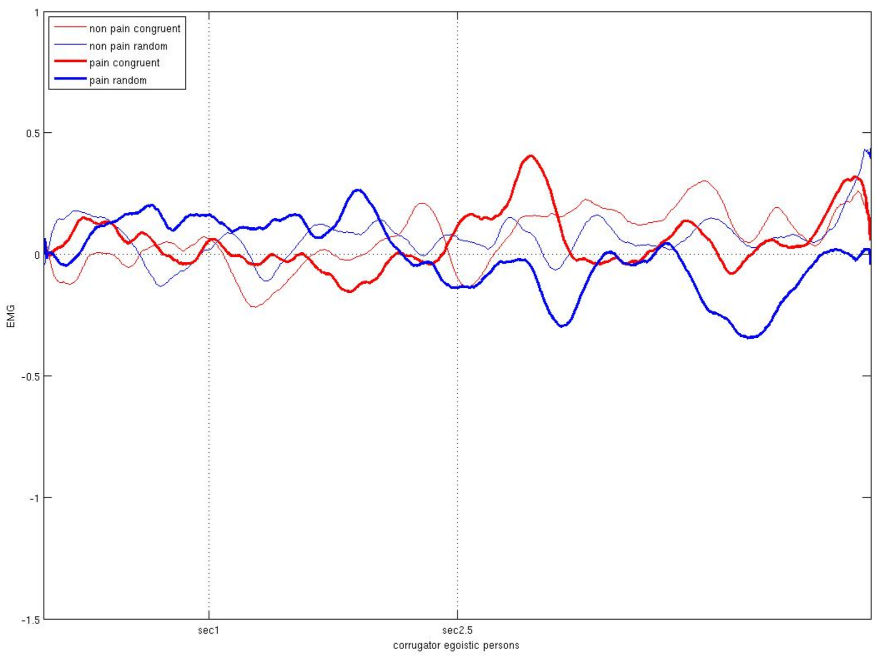


Fig. 6b. *Averaged M. Corrugator Response Curves Over Time During the Empathy Task of Only the Egoistic Group.*



M. orbicularis oculi - startle reflex. In the course of the pre-processing, we extracted a 500ms post-stimulus period where we only counted eye-blinks that showed a peak of activity within 100-250ms after startle probe onset; the probe onset was 50ms after trigger delivery. We took a 20ms post-stimulus period as the baseline.

For the statistical analysis we used the pre-processed amplitude of the startle response that was computed using standardized, *t*-transformed (based on the mean and standard deviation across all trials per condition) and winsorized peak amplitudes of all trials, separately within the congruent/random and pain/non-pain condition, where a startle stimulus appeared. It resulted in six trials per condition combination. Winsorizing means a correction for outliers that contained an equalization of responses that were greater than 3 *SD* away from the mean, to a maximal variance of 3 *SD* again (Waugh, Thompson, & Gotlib, 2011). Individual differences in startle magnitude were thus standardised (Waugh et al., 2011). We included non-zero eye blinks in our analysis, which are all trials with a response, but excluded non-responders' data that were initially set to zero. Non-responders are those participants who show less than 2 startle responses per condition (Waugh et al., 2011).

A 2 (pain conditions: pain, no-pain) x 2 (imitation conditions: congruent, random) repeated-measures ANOVA did not yield any significant effects within the analysed conditions. Surprisingly, all startle amplitudes reached approximately the same levels (M_{Pain_Cong} = 49.08, SD_{Pain_Cong} = 3.04; M_{Pain_Rand} = 49.47, SD_{Pain_Rand} = 3.49; $M_{NonPain\_Cong}$ = 49.61, $SD_{NonPain\_Cong}$ = 2.55; $M_{NonPain\_Rand}$ = 49.85, $SD_{NonPain\_Rand}$ = 4.07) and did not differ from each other (see Table 2). Thus, we can assume that neither the imitation priming, nor the different pain levels had an influence on the eye-blink reflex.

Table 2. *Imitation x Pain Repeated-Measures Analysis of Variance for Startle Amplitudes.*

Source	F	p	η^2
(A) Imitation	.28	.598	.01
(B) Pain	.24	.625	.01
A x B (interaction)	.02	.895	.00

Note. (A) Imitation = congruent, random. (B) Pain = pain, non-pain. *n* = 29. df = 28.

DISCUSSION

Summary of results

This within-subject experimental study with two groups aimed to investigate the effects of motor imitation on empathy and prosocial behaviour, taking into account the impact of two distinct imitation conditions. The research questions were: does implicit imitation by person A compared to person B (who does not imitate) increase later empathy for this person A? Does implicit imitation lead to an increase in the prosocial attitude towards person A? Are such effects of imitation on prosocial behaviour mediated by increases in empathy?

Previous research showed that imitation has a positive effect on the development of empathy and helping behaviour. The Chameleon effect has been widely replicated with success - however, a sufficient explanation concerning the underlying mechanism is still missing. With the current study we intended to assess the mechanism behind the positive effects of imitation by testing two imitation conditions (congruency vs. contingency) in order to explore which condition is necessary for enhancing empathy. Additionally, we used psychophysiological methods such as facial electromyography and the skin conductance response (EDA). The measurement of the autonomic nervous system's activation within the *M. corrugator supercilii* and *M. orbicularis oculi* took place; the amplitude of the startle reflex elicited by an acoustic stimulus was analysed. However, these psychophysiological measures were just used to assess subtle expressions of empathy and were a complement to the central questions whether it is the perception-action model or contingency that drive the Chameleon effect.

Based on existing literature, two explanatory models have been proposed: first, the perception-action model (PAM), according to which we automatically and unconsciously imitate others as the perceptual sensory representation system is getting activated when perceiving an action. Simultaneously, the motor representation system of the action is getting activated as well, which results in higher likelihood for performing the same action that has been observed. Imitation does not only cause the tendency to act the same way but also it may result in empathy and the tendency to help the person in need and show prosocial behaviour.

Second, the contingency hypothesis, according to which automatic imitation occurs even in the absence of a direction-of-movement-overlap, but due to the mere enjoyment of getting a well-timed response to one's own behaviour. We thus asked ourselves whether movement congruency is required or temporal contingency is sufficient for positive effects on empathy and prosocial behaviour.

The analysis of behavioural data showed that we were able to induce empathy with our manipulation. Both groups indicated a higher rating of empathy variables for pain trials relative to non-pain trials, which allows the assumption that that the participants distinguished between the two pain conditions. Nevertheless, we did not find a difference in empathy ratings for the imitating and non-imitating person.

As for the affiliation ratings, we found a trend only in the congruent condition (significantly higher perception of connectivity with the congruent person and higher, but not significant, familiarity and sympathy for the congruent person). We had to reject the hypothesis (H1) that postulated an increase of empathy due to movement congruency. The same applies to group 2 where data showed no increase of empathy due to temporal contingency.

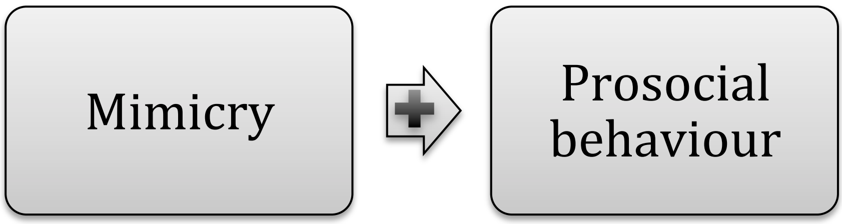
As for the psychophysiological data, repeated-measures ANOVAs of the corrugator revealed only a slight trend towards a possible differentiation between the congruent and random condition and a significant main effect regarding the activation over time. Taking into account the overall non-significant activation of the orbicularis and thus no differences within the startle reflex, we have to reject the H1 as far as it concerns both behavioural and psychophysiological data. Our investigation revealed that no increase of empathy due to imitation could be assumed.

Further analysis of behavioural data showed that in the course of the prosocial task, the congruent co-player was significantly favoured over the random co-player; 23 out of 32 participants chose the congruent player. In contrast, only 17 participants favoured the contingent over the random co-player that did not turn out to be significant. Thus, we can accept the hypothesis (H2) and assume that there is an increase in the prosocial attitude due to movement congruency but not due to temporal contingency. At the same time, this allows us to accept the hypothesis (H4) that temporal contingency is not an effector for the positive outcomes of the Chameleon effect.

Several binary logistic regressions showed that prosocial attitude elicited by imitation is not mediated by empathy. More precisely, neither the choice of whom to help could be predicted by empathy or affiliation ratings, nor prosocial behaviour itself could be predicted by empathy ratings across conditions. Therefore, we rejected that hypothesis (H3).

To sum up, we did not find any effects of movement congruency or temporal contingency on empathy, which is not in line with previous research. Only movement congruency, but not temporal contingency, triggered a clear preference in prosocial behaviour. Taken together, movement congruency is required for positive effects of imitation on prosocial behaviour but we could not show any effects on empathy. Figure 7 gives a schematic overview of the process we found out through our manipulation.

Fig. 7. *Schematic Overview of the Process Underlying the Effects of Motor Imitation as Found With Our Study.*



How can we explain these findings? We could find positive effects of movement congruency within group 1: congruency seems to initiate the expression of prosocial behaviour. Although our results do not fully support our initial proposition of how the underlying process might look like as positive effects on empathy are missing (see Fig. 1), we can still say that our results allow us to partially accept the PAM as an explanatory model. If we refer the positive influences only to changes in prosocial behaviour, then we can assume that both a temporal overlap and a directional overlap of movements are required to elicit these positive effects. In this sense, the PAM can be supported and we consider it as being the more plausible explanation for the Chameleon effect.

At this point the question arises of whether we did not find any effects on empathy because there simply are none, or whether there are indeed effects on empathy but our measurement methods were not sensitive enough to detect them. There are a number of possible arguments for and against these assumptions.

Assessing empathy. It is not easy to investigate empathy accurately as there are various aspects to consider and variables to control for. Our attempt to create a naturalistic social interaction setting as well as to control for confounding variables such as differences in movements between two individuals, initial sympathy or preference may have led to a situation in which the entire manipulation was simply too abstract in terms of understanding the reactions of others - as we did not show faces of the co-players and no bodily reaction to pain stimulation was visible, it may have been too difficult to start emphasizing with another person without certain cues. Usually, you see the reaction on the face or the posture and interpret someone's emotional state according to this information you get. We did not provide the participants with this additional information, which may have led to the fact that it was too abstract. This may be one possible explanation for the non-significant fEMG results and the lack of empathy in our study. Other studies with empathy for pain presented i.e. pictures of hands and feet in painful and non-painful conditions that provided a link to situations in everyday-life that may have been easy to comprehend (Jackson et al., 2005). Another study by Singer et al. (2004) examined how individuals feel about their partner's state when the partners receive painful stimulation. Gerdes et al. (2012) used pictures of happy and angry faces and then applied painful stimulation to the participants - they investigated the influence of pain on the processing of happy and angry faces. That kind of manipulation lacked a link to everyday-life experiences, however. It seems that it is a challenge to combine different components in one manipulation. Also, our participants might have forgotten the created identity of the two co-players - as the imitation priming in the first task was intended to be rather subtle and thus the information about both co-players was unconsciously memorized, the switch to the second task might have led to the extinction of this information.

Given the fact that it was also a presumed to be a group setting, they might have been too concentrated on trying to work out whether the other co-players really existed or not. This focus might have prevented them from really empathising with the co-players. The assessment of whether perceived emotions are real or not is essential in this case. According to Stel et al. (2008), empathy will only be enhanced by imitation when the perceived emotions are rated as real. If there was doubt as to whether the co-players exist, and therefore whether their emotions were actually real, then it might be that no empathy was elicited, which could explain the missing psychophysiological responses.

When talking about the realness of emotions, the question arises as to whether our solution of how to reflect the event of pain delivery was efficient enough. As our intention was to investigate the influence of mere motor imitation, we showed only the upper body, but no head or face, during the whole experiment. One can assume that because of that, the setting appeared to be rather impersonal and participants were unable to establish a personal link to the co-players. On the one hand it is exactly what we wanted, namely to avoid any personal variables, but on the other hand, it may have fostered the creation of a certain degree of abstraction. Nonetheless, Singer et al. (2004) argue that it does not make any difference if emotional facial cues are present or absent. It has been shown that even if no emotional expressions are visible, a presentation of any random cues, which signal the emotional state of others, may evoke empathy. The flash that we selected as a pain anticipation cue and a pain delivery cue, being presented right in front of a person, should therefore be sufficient. Besides, even if the sufficiency of a random cue instead of real emotional expressions would not be given, the fact that our participants also experienced pain on their own should have served as a useful information for them in the course of following evaluative judgments about the co-players' state. West and Bruckmüller (2013), who investigated the effectiveness of imagined contact, found that meta-cognitive experiences serve as a great information source - we use our own feelings and experiences when forming judgments about situations or topics with which we were not in direct contact. We therefore make use of the "How do I feel about it" - heuristic (Schwarz & Clore, 1988; as cited in West & Bruckmüller, 2013) and transfer our own feelings to the assessment of the state of others. The authors also suggest that if a stimulus is difficult to interpret, i.e. when an emotional expression is not visible and a flash covers the view as in our case, the perceptual fluency is low, which results in more negative attitudes and maybe in lower motivation.

Our final results do not support these hypotheses, however. It seems that it was rather insufficient to forego emotional cues. It could also be problematic to use many various cues like the different colours of the flashes. Although we explained the meaning of the colours at the beginning of the empathy task and at the beginning of each block at least the kind of stimulation (painful or non-painful) was mentioned, it might have been too much information to process. Low perceptual fluency might also have evoked a negative attitude towards the task that might have resulted in low participation willingness, resulting in increased prejudice rate, as was the case in the study of West and Bruckmüller (2013).

Empathy and affiliation ratings. In our study we presented the individuals two distinct rating questionnaires with empathy- and empathy-related variables that were presented right after pain shock blocks, as well as at the end. This procedure has already been tried out and is similar to other studies (e.g. Stel et al., 2008). As we could find evidence for higher affiliation in terms of perceived connectivity, familiarity and sympathy for the congruent person, but no evidence for higher empathy, it might suggest that affiliation is either a totally distinct concept and is not related to the concept of empathy, or that it is a preliminary stage of empathy and is required but not sufficient to elicit empathy. Also, the ratings were rather low for all variables (see Table 1 for means of empathy ratings and Table

2 for means of affiliation ratings). This might indicate that the ratings may not have measured empathy in an appropriate way, as the questions we asked might have been too short and too subliminal, or that the ratings were actually sufficient but the manipulation setting has been too abstract too elicit empathy.

The finding that our empathy ratings did not turn out to be related to prosocial behaviour indicates that there still might be a hidden relationship of multiple factors that we have not yet found. It might be of great interest to investigate the role of dispositional traits as well. In-depth studies of differences between expressions of characteristics on particular questionnaire scales illustrate that empathic responses may also reflect a combination of implicit traits (e.g. Avenanti et al., 2005; De Coster et al., 2013). Our post-hoc analysis for corrugator data of prosocial/egoistic persons indicate that it might be worth distinguishing between these two groups of individuals, as there might be interpersonal differences.

Cognitive styles. There is evidence for a relationship between mimicry and the cognitive style, namely context or field dependency. Van Baaren et al. (2004) found out that field-dependent individuals are more attentive to social cues, are more open to contextual variables and, thus, can be more influenced by the behaviour of others. Furthermore, they argue that this relationship may be bidirectional; therefore, overt exposure to mimicry may change the cognitive style and influence the way an individual reacts to the environment. The degree of field dependency also appears to be culture-specific; Europeans are thought to be rather field-independent (Triandis, 1989; Van Baaren et al., 2004). These aspects may be important in understanding our results: it might have been difficult for our participants to react meaningfully to motor imitation, if we assume that they were rather field-independent. If they were used to relying on more clear variables when being exposed to mimicry, then the mere manipulation of the motor behaviour would have been simply too subtle to elicit empathy. Although it seemed to be enough to elicit prosocial behaviour, that could be explained by the bidirectional aspect of the relation of cognitive style/mimicry.

Another interesting paper by Waugh et al. (2011) that investigated psychophysiological reactions to emotional pictures implies that highly resilient individuals succeed in monitoring environmental changes by reacting with more divergent affective and facial responses. They also show coping strategies to better deal with stress such as producing a higher startle reflex. As our manipulation indeed contained stressful situations when the painful stimulations were applied, it would have been interesting to assess the individual's resilience capacity, i.e. with a resilience questionnaire (ER89).

Relaxation hypothesis. As far as psychophysiological reactions are concerned, our results show that different corrugator activations were elicited over time. We cannot say that this is due to implemented conditions, however. When looking at Fig. 4, presenting the averaged fEMG response over time, one can see that the activation curve for the *non-pain congruent condition* is different in its development, though not significant: right after the beginning of pain anticipation it starts to go down, the activation is getting gradually negative with a visible distance to other curves. A possible explanation for this trend might be that participants were less tensed when they observed their congruent co-players, who happened to elicit more affiliation in them, especially during non-painful trials - the knowledge about the upcoming event, a non-painful shock, signalling decreased pain might have caused relief and therefore a relaxation of the corrugator muscle group. For all other conditions, they were still tensed and the arousal was high. Interestingly, the decrease can be seen already before the anticipation event. But this is because they knew that the whole block would include only non-painful stimulation.

The same development can be observed in the activations of only prosocial persons (Fig. 5a), but not in the activations of only egoistic persons (Fig. 5b). It seems that the prosocial group reacted with even higher relaxation to the event of pain shock delivery - the curve goes abruptly down and the corrugator activation reaches its peak around -1 µV. Generally, all fEMG curves go down after the event of pain shock delivery.

It is noteworthy that the egoistic group seems to be different from the prosocial group and also the entire averaged group 1. Their fEMG activations do not show any extraordinary development and the voltage stays between 0.3 and -0.3 µV. Peaks in the activation can be detected after the event of pain delivery, whereby egoistic persons reacted with higher arousal to "pain congruent", which is reflected by positive voltage, and muscle relaxation to "pain random", which is reflected by negative voltage. This would fit the explanation that people react with arousal to painful stimulation of their preferred players and, respectively, that they should not be bothered by painful stimulation of players to whom they do not have any strong affiliation.

Other researchers who detected similar muscle relaxations, however, propose different interpretations. Avenanti et al. (2005) who investigated empathy for pain with transcranial magnetic stimulation (TMS) and EMG by showing individuals videos of hands or feet being penetrated by needles versus neutral objects, found a reduction of motor excitability in corresponding limb muscles. These reductions might be due to the fact that pain has a paralysing effect when externally applied to bodily parts. That paralysing effect might be reflected by the observer of pain and would be reflected in a reduction of motor excitability in corresponding muscles, which is what we regard as a muscle relaxation. These results could fit our explanation of a muscle relaxation reflecting a particular empathic response. However, we did not connect EMG electrodes to the hand to which we applied the electrical stimulation to and we do not know anything about the motor excitability in that muscle area. The study of Avenanti et al. (2005) indicates that a lack of obvious motor arousal does not necessarily imply a lack of experienced empathy.

Affective vs. Cognitive Empathy. Empathy is differentiated into affective and cognitive forms, whereby affective empathy concerns emotional contagion and cognitive empathy includes perspective taking (i.e. Preston & de Waal, 2002; Singer & Lamm, 2009; Stel et al., 2008; Stel & Vonk, 2009). Stel at al. (2008) postulates that mimicry in particular leads to emotional contagion, which is why one can assume that it affects the affective form of empathy to a greater extent. The intention of our study was to assess the driving process of the Chameleon effect; therefore we took a closer look at the *affective* forms of empathy. However, there is reason to assume that both forms are not that easy to separate from each other: various researchers argue that empathy consists of a number of important components that cannot be simply left out; i.e. you need to evoke emotional contagion and changes in perspective-taking in order to evoke empathy (Preston & de Waal, 2002). Regarding Avenanti's et al. (2005) even finer distinction of empathic components, empathy for pain may rely on basic somatic representations, which become active before the affective-motivational part of empathy arises. We, however, strictly aimed to exclude emotional contagion by not showing facial cues. Maybe this is the reason why we failed to elicit empathy as a whole - we did not show exact pictures of painful occasions, instead we conducted a task where participants first had to *imagine* what others feel, as they did not see any corresponding reactions, and they were then expected to experience empathy. This capacity to imagine another person's state is part of the cognitive form of empathy, also called the Theory of Mind (Stel et al., 2008). Stel et al. (2008), however, also argue that affective empathy represents a basic level and thus shall be induced in any case - the expression of emotions happens automatically, the second step is to think about the event and that deliberating process stimulates the cognitive processing. On the other hand one can suggest that only at the level of cognitive empathy do behavioural changes occur as the result of cognitive changes.

Observing a person in pain and the following prosocial behaviour may be ruled by complex top-down processing which is led by multiple cognitive mechanisms (De Coster et al., 2013).

These arguments suggest that we have assessed top-down processing or cognitive empathy by using methods (fEMG, skin conductance response) that are usually used to measure affective empathy (De Coster et al., 2013; Gerdes et al., 2012; Wolf et al., 2005). Our findings would also imply the contrary of the assumption that only when emotions are perceived as real can cognitive empathy be enhanced by imitation, as stated by Stel et al. (2008).

Prospects for future research

There are a number of innovative aspects that our study focused on. However, it also provides new feedback as to what we should consider when assessing the Chameleon effect and its origins. Many social neuroscientists have complained about a lack of naturalistic settings in such studies. We tried to introduce that kind of study design by establishing a connection between motor imitation and empathy. Therefore we encourage other researchers to continue on this level, as we believe that naturalistic social interaction designs are very important as they provide the participants with more freedom concerning their behavioural decisions and emotional responses. However, a more concrete connection between the single tasks would be desirable. It may even be interesting to conduct a manipulation where one induced imitation and empathy at the same or with a shorter time delay between the experimental blocks.

Getting more information regarding dispositional traits would be useful as well, as it might explain behavioural or psychophysiological outcomes. Of course, psychological tests such as validated questionnaires would only present an additional informational source, as we should not forget the human tendency to socially acceptable responses. However, one might benefit from a comparison of both data sets. It could also be interesting to investigate cognitive styles, in addition to affective components. More precisely one could include e.g. a simple Theory-of-Mind-related task at the beginning of the experiment that would show the extent of a person's capacity to modulate his or her own perspective. If that capacity turns out to be low, then the experimenter could adjust the manipulation by adding more variables that help the participant to correctly understand the setting. In any case, the number of these extra variables should be precisely defined in advance.

All in all, further research on the functional mechanisms that drive the Chameleon effect are highly recommended. Obtaining knowledge about the nature of this phenomenon might help understanding impairment and mental disorders in social functions, such as in autism spectrum disorders, social behaviour disorders and certain types of personality disorders and schizophrenia (Knoblich & Sebanz, 2006). Besides, there are also a number of psychopathologies with empathy deficits (Blair & Blair, 2009). Information about the process of how empathy and prosocial behaviour are possibly elicited would certainly promote better therapeutic approaches as well as new diagnostic strategies. One could even take into consideration including motor imitation as a variable in the diagnostic process. Knowledge about neuronal origins would serve an important role as well, similarly promoting a better understanding not only of the mentioned disorders but also of acquired disorders of psychological functions due to head injuries and concussions that affect the prefrontal cortex.

General Limitations

The current study was conducted using a well-controlled design. Still, it is possible that some confounding variables interfered with the final results. Although we investigated the effects of imitation in a naturalistically social interaction setting and used presumably spontaneous movements, imitation did not have a social function in our study. This was because the joystick task did not provide an actual real-life context, and apart from using the same co-players during the whole procedure, there was no logical link to other parts of the experiment. Therefore, it is hard to apply the effects of this manipulation on everyday life as one does not simply play a joystick game, which is not a real game but simply includes the request to move the joystick while observing others doing the same supposedly random movement. Besides, some participants reported having experienced difficulties to stay fully awake and keep their attention on the rather monotonous procedure. Although the testing time is a small detail, it might have helped to reschedule the testing to the afternoon instead of early morning.

During the 120 trials of the joystick task the general activity level may have decreased, which might have caused the effect that participants were too inattentive during the following empathy task, which was cognitively more demanding as one had to concentrate on the shocks and the other person's perception of the pain.

Moreover, our joystick and empathy task might have been too long. Other fEMG-studies used shorter durations, i.e. Gerdes et al. (2012) presented eight blocks of 10 trials each with a trial duration of 3.5 s, an ITI of 2 s, thus a total block length of 1.2 min; De Coster's et al. (2013) experiment consisted of 36 trials, whereas each time one part of the task had a

duration of 2 s, another - 8 s. We, however, implemented 72 trials in the empathy task alone, an ITI of 17 s and a total length of the experiment of approximately 1.2 hours. The break between the joystick task and the empathy task that we used for the preparation of the fEMG- and SC-measurements, as well as the time lapse between the experimental blocks, might have been too long as well.

Another critique point is the procedure of the empathy task. Although we excluded from the data analysis all the participants who reported having experienced too low electrical stimulation or shocks in-between trials or inappropriate stimulation, we still cannot be sure whether all the included participants effectively received the appropriate stimulation in the course of the entire empathy task. On the one hand, the experience of too low electrical stimulation could have led to insufficient perception of pain, which would hamper the development of understanding of how others suffer during similar painful stimulation and therefore, no empathy could have been developed. On the other hand, inappropriate stimulation, which either occurred without any warning or where the pain level fluctuated over time, could have led to fear or anger because of the unpredictable component, which could also have led to a shift of attention and a lack of empathy again.

As for the instruction, even though it was clearly set, we cannot be sure whether the way in which the instruction was presented to the participants was accurately standardized, given the fact that several experimenters were engaged in the testing procedure. As we intended to assess unconscious empathy, the participants were explicitly not asked to try to feel empathic. However, it might have been the case that the term "empathy" was mentioned sometimes during the instruction.

Finally, our sample size of 32 participants might have been too small and as we had to exclude several data sets during the pre-processing, and our final samples for the startle reflex contained 29 participants and the corrugator sample only 27 participants, this may have led to non-significant results in the end.

Conclusion

The main characteristic of the Chameleon effect is automatic and unconscious imitation that fosters the effect of liking the imitating person. The general explanatory model used in this study now emphasizes the role of motor imitation, appearing in two forms - movement congruency and temporal contingency, which elicits empathy and leads to prosocial behaviour. No effects of temporal contingency alone could be found in this study. Movement congruency influenced prosocial behaviour in a positive way, but it did not affect empathy. I therefore partially accept the PAM as being an explanatory model for the Chameleon effect; however, it seems to be applicable only to prosocial behaviour. Our study successfully outlined that an overlap of time and similarity is needed to elicit prosocial behaviour and that humans already respond to inconspicuous situational components such as motor movement patterns. As for the empathic response, the underlying mechanisms may be different. Empathy seems to need more than a temporal and directional overlap. Research has so far already emphasized that empathy is a complex construct that sometimes still has to be separated from the simple PAM mechanisms (Preston & de Waal, 2002). Even though PAM is obviously more complex than temporal contingency alone, the model posits that the mere overlap of both components automatically and unintentionally results in positive outcomes. We, however, showed that the underlying mechanisms of the Chameleon effect are many-sided and that further variables might be needed in order to elicit empathy and prosocial behaviour when studying motor mimicry.

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Appendix A

Table 1. *Manipulation Test and Means (Standard Deviations) of Empathy Ratings, Divided Into Pain and Imitation Conditions. Rating Scale Range: -240 (low) - 240 (high).*

Pain condition	Imitation condition	Empathy rating variable			
		Painful	Unpleasant self	Distressed	Compassionate
P	C	-17.97*** (146.22)	-80.72*** (136.15)	-88.44*** (142.76)	-73.59*** (153.82)
P	R	-21.88*** (135.14)	-94.84*** (133.70)	-99.06*** (129.69)	-78.13*** (139.03)
NP	C	-177.19 (60.81)	-176.56 (95.64)	-167.66 (102.41)	-151.09 (113.73)
NP	R	-180.63 (61.56)	-180.63 (99.93)	-187.34 (97.41)	-164.06 (100.66)

Note. P = Pain, NP = Non-Pain, C = Congruent, R = Random. $n = 32$.

***$p < .001$ based on Wilcoxon Signed Ranks Test.

Appendix B

B. Abstract

Recent studies have shown that interactions partners show a tendency to automatically imitate each other, which has positive effects on liking. This phenomenon is called "the Chameleon effect". The aim of the current study was to assess whether imitation also affects empathy and prosocial behaviour and to clarify the functional mechanisms that drive this phenomenon. Based on previous findings two explanatory models will be discussed in detail: the action-perception link and the contingency hypothesis. Participants took part in a presumably interactive online game with two co-players where their arm movements were imitated by one of the co-players. They received, and observed the co-players receiving, painful stimulations afterwards. Empathy was measured using behavioural ratings, facial EMG, the startle response and the skin conductance response. In the end, participants were assigned to select one of the co-players for helping. Their preference for one co-player as well as the decision concerning on whose behalf they would take the painful stimulation was assessed with a forced-choice task and was a measure of whether imitation affects prosocial behaviour. Behavioural data showed that movement congruency has a positive effect on prosocial behaviour, but not on empathy. EMG data showed no influence of pain or imitation; only activation of M. corrugator supercilii tended to be more negative within the non-pain congruent condition, but no interaction within other factors has been found. Startle amplitudes did not differ across conditions. Our findings suggest that motor imitation elicits prosocial behaviour but does not affect empathy, which is why more precise factors are needed when exploring empathy.

Keywords: Chameleon effect; Action and perception; Empathy; Imitation; Congruency; Contingency; Prosocial behaviour; Facial electromyography (fEMG); Startle response; Pain

Appendix C

C. Zusammenfassung

Aktuelle Studien haben gezeigt, dass Interaktionspartner einen automatischen Reflex haben andere zu imitieren, was einen positiven Effekt auf Zuneigung hat. Dieses Phänomen wird der "Chamäleoneffekt" genannt. Die vorliegende Studie beabsichtigte zu untersuchen, ob Imitation auch Empathie und prosoziales Verhalten bewirkt und den dahinterliegenden funktionnellen Mechanismus zu klären. Zwei potentielle Erklärungsmodelle lassen sich aus bestehender Literatur ableiten: ein Wahrnehmungs-Handlungs-Modell und die Kontingenz-Hypothese. Versuchsteilnehmer/innen nahmen an einem interaktiven Onlinespiel mit zwei anderen Mitspielern teil. Dabei imitierte einer der Mitspieler die Armbewegungen der Versuchsteilnehmer/innen. Als nächstes wurden allen Beteiligten in abwechelnder Reihenfolge Schmerzreize verabreicht. Empathie wurde anhand von behavioralen Ratings, fEMG, dem Startle Reflex und Hautleitwerten erfasst. Abschließend mussten die Versuchsteilnehmer/innen einen der beiden Mitspieler aussuchen und ihm helfen oder nicht. Die Präferenz für einen Mitspieler, sowie die Entscheidung wem sie Schmerzreize abnehmen, wurde mit einer Forced-Choice-Aufgabe erfasst und war ein Maß dafür, ob Imitation prosoziales Verhalten beeinflusst. Verhaltensergebnisse zeigten, dass Bewegungskongruenz einen positiven Effekt auf prosoziales Verhalten hat, jedoch nicht auf Empathie. EMG-Ergebnisse zeigten keinen Einfluss von Schmerz und Imitation. Die Aktivität des M. Corrugator Supercilii neigte dazu bei der non-pain congruent Bedingung negativer zu sein, jedoch wurden keine Interaktionen mit anderen Variablen gefunden. Startle Amplituden unterschieden sich nicht in den Bedingungen. Zusammenfassend implizieren unsere Ergebnisse, dass Bewegungsimitation prosoziales Verhalten, aber nicht Empathie hervorruft, weswegen der Einsatz von präziseren Faktoren zur Erforschung von Empathie notwendig erscheint.

Schlagworte: Chamäleoneffekt; Wahrnehmung und Handlung; Empathie; Imitation; Kongruenz; Kontingenz; prosoziales Verhalten; Elektromyographie (fEMG); Startle Reflex; Schmerz

Appendix D

D. Material

D.1 General pre-information about the study

Allgemeine Vorinformationen über die Studie

„Einfluss von selbstbestimmten und vorgegebenen Bewegungen auf Schmerzempfinden und -wahrnehmung in einem Online-Setting"

Vielen Dank für Ihr Interesse an Teilnahme an unserer Studie!

Wie läuft die Studie ab?

Die Studie besteht aus zwei Teilexperimenten: eine Joystickaufgabe und eine Aufgabe in der bei den TeilnehmerInnen ihr eigenes Schmerzempfinden und die Einschätzung des Schmerzempfindens anderer Personen untersucht werden. Die Aufgaben werden online in einer Gruppetestung gespielt. Nach den Aufgaben sollen Sie noch einige weitere kurze Computeraufgaben machen und einige Fragebögen ausfüllen. Bei der Testung werden Sie über jede Aufgabe noch genauere Instruktionen erhalten.

Elektrische Stimulation am Handrücken

Im zweiten Teil der Studie werden bei allen TeilnehmerInnen ihr Schmerzempfinden und die Einschätzung des Schmerzempfindens der anderen TeilnehmerInnen untersucht. Dabei werden Ihnen elektrische Stimulationsreize am Rücken der Hand verabreicht, die in manchen Durchgängen schmerzhaft sind. Diese Stimulationsmethode wurde schon vielfach angewandt. Die Schmerzwirkung ist sehr kurz und es sind keine Nebenwirkungen oder das Experiment überdauernde Folgewirkungen bekannt. Auch werden Sie in diesem Teil über Kopfhörer ab und zu laute Geräusche hören. Wenn Sie an Tinnitus oder Hyperacusis leiden, ist Teilnahme an dieser Studie daher nicht zu empfehlen.

Dauer und Aufwandsentschädigung

Die Studie wird zirka 1,5 bis 2 Stunden dauern. Die Aufwandsentschädigung beträgt €15,00.

Einhaltung der vereinbarten Termine

Die Studie ist eine Gruppentestung; das heißt dass an der Messung noch zwei andere TeilnehmerInnen beteiligt sind, mit denen sie während einiger Aufgaben über eine Webcam verbunden sind. Bitte nehmen Sie deswegen besonders Rücksicht darauf *pünktlich zu dem vereinbarten Termin zu kommen*! Das Experiment kann nur stattfinden, wenn alle drei Teilnehmer erscheinen und beginnt auch erst wenn alle drei anwesend sind. Falls Sie Ihre Teilnahme absagen müssen, tun Sie das bitte bis spätestens 48 Stunden vor dem vereinbarten Termin. So kann versucht werden noch eine/einen Teilnehmer/In zu finden, bzw. kann den anderen beiden rechtzeitig abgesagt werden.

Kontaktdaten

Die Studie findet an der Social, Cognitive and Affective Neuroscience Unit, an der Fakultät für Psychologie, Liebiggasse 5, 1010 Wien statt. Wenn Sie weitere Fragen in Zusammenhang mit dieser Studie haben, kontaktieren Sie bitte Frau Mag. Birgit Rauchbauer: birgit.rauchbauer@univie.ac.at

D.2 Information presented prior to the participation at the experiment and informed consent

Probandeninformation und Einwilligungserklärung zur Teilnahme an der Studie

<u>Einfluss von spontanen versus vorgegebenen Bewegungen auf Schmerzempfinden und Schmerzbeurteilungsfähigkeit in einem online Gruppensetting</u>

Sehr geehrte Probandin/sehr geehrter Proband!

Wir laden Sie ein, an der oben genannten Studie teilzunehmen. Die Aufklärung darüber erfolgt in einem ausführlichen Gespräch.

Ihre Teilnahme an dieser Studie erfolgt freiwillig. Sie können jederzeit ohne Angabe von Gründen aus der Studie ausscheiden. Die Ablehnung der Teilnahme oder ein vorzeitiges Ausscheiden aus dieser Studie hat keine nachteiligen Folgen für Sie.

Experimentelle Studien sind notwendig, um verlässliche neue Forschungsergebnisse zu gewinnen. Unverzichtbare Voraussetzung für die Durchführung einer Studie ist jedoch, dass Sie Ihr Einverständnis zur Teilnahme an dieser Studie schriftlich erklären. Bitte lesen Sie den folgenden Text als Ergänzung zum Informationsgespräch mit dem Versuchsleiter sorgfältig durch und zögern Sie nicht, Fragen zu stellen.

Bitte unterschreiben Sie die Einwilligungserklärung nur, wenn

- Sie Art und Ablauf der Studie vollständig verstanden haben,
- Sie bereit sind, der Teilnahme zuzustimmen und
- Sie sich über Ihre Rechte als Proband an dieser Studie im Klaren sind.

1. Was ist der Zweck der Studie?

Die Social, Cognitive and Affective Neuroscience Unit der Fakultät für Psychologie der Universität Wien beschäftigt sich schwerpunktmäßig mit verschiedenen Aspekten sozialer und kognitiver Phänomene. In dieser Studie geht es um die Effekte von spontanen (selbstbestimmten) versus instruierten (vorgegebenen) Handbewegungen in einem online Setting auf Bewegungsablauf, Schmerzempfinden und –wahrnehmung. In der Untersuchung wird eine Bewegungsaufgabe am Computer auszuführen sein und leichte elektrische Stimulation angewandt.

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2. Wie läuft die Studie ab?

Ihre Aufgabe

Das Experiment besteht aus drei Aufgaben. Die Aufgaben werden hier kurz beschrieben. Später werden Sie für jede Aufgabe noch genauere Instruktionen erhalten.

1. Online Joystickspiel

Im ersten Teil des Experiments werden Ihre Handbewegungen untersucht und aufgezeichnet. Sie sollen nach jedem Hinweisreiz spontan bestimmen, ob sie eine Joystickbewegung nach links oder rechts ausführen oder den Joystick gar nicht bewegen. Während der Aufgabe sind Sie über eine Webcam mit jeweils einem der zwei anderen TeilnehmerInnen verbunden. Sie und die anderen TeilnehmerInnen sind in eine von zwei Versuchsgruppen eingeteilt. In Ihrer Gruppe sollen Sie selbst entscheiden, ob und in welche Richtung Sie den Joystick bewegen.

Die Webcams werden so eingestellt, dass nur Ihr Oberkörper und die Bewegungen, die Sie ausführen, sichtbar sind. Jeder von Ihnen bekommt zu Beginn der Studie einen farbigen Kittel zum Überziehen, sodass Ihre persönliche Kleidung nicht sichtbar ist. Sie werden die anderen TeilnehmerInnen zu keiner Zeit treffen oder etwas über ihre Identität erfahren.

2. Schmerzempfinden und –Wahrnehmung

Im zweiten Teil der Studie werden wir Ihr Empfinden und Ihre physiologischen Reaktionen messen wenn Sie selbst einen Schmerzreiz am Handrücken erhalten, oder eine andere Person in dieser Situation sehen. Hierzu werden bei ihnen und den anderen TeilnehmerInnen elektrische Stimulationsreize am Rücken der Hand verabreicht, die in manchen Durchgängen schmerzhaft sind.

Diese Methode wurde schon vielfach angewandt. Die Schmerzwirkung ist sehr kurz und es sind keine Nebenwirkungen oder das Experiment überdauernde Folgewirkungen bekannt. Da jeder Mensch ein unterschiedliches Schmerzempfinden hat, wird die Stärke der elektrischen Stimulation zu Beginn individuell auf Ihr eigenes Schmerzempfinden abgestimmt.

Während der Aufgabe werden Sie per Webcam sehen wann die anderen TeilnehmerInnen Stimulationsreize erhalten. Dabei werden Sie gebeten sowohl Ihr Empfinden, als auch ihre Einschätzung des Empfindens der anderen TeilnehmerInnen auf einer Skala einzustufen. Auch werden Ihre körperlichen Reaktionen wie Hautleitwert und Gesichtsmuskelaktivität (EMG) gemessen. Ebenfalls werden Sie während dieser Aufgabe über Kopfhörer in manchen Durchgängen einen kurzen lauten Ton (Rauschen) hören, die als unangenehm empfunden werden kann. Vor Anfang der Aufgabe werden Sie in einigen Gewöhnungsdurchgängen mit dem Geräusch vertraut gemacht.

3. Fragebögen

Im dritten und letzten Teil des Experiments wird die Webcam-Verbindung abgedreht. Abschließend werden Sie dann noch weitere Entscheidungsaufgaben am Computer durchführen, und kurze Fragebögen ausfüllen.

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3. Worin liegt der Nutzen einer Teilnahme an der Studie?

Die Teilnahme an dieser Studie hat für Sie persönlich keinen unmittelbaren Nutzen. Die Ergebnisse dieser Studie sollen aber wichtige neue Erkenntnisse bezüglich dem Zusammenhang zwischen Bewegungs-Entscheidungen und der eigenen Schmerzempfindungsfähigkeit und jener anderer Personen liefern.

4. Gibt es Risiken, Beschwerden und Begleiterscheinungen?

Die Stimulation mit elektrischer Reizung ist bereits vielfach, auch mehrmals hier in der SCAN-Unit, angewandt und erprobt worden, und stellt eine etablierte und sichere experimentelle Methode dar. Die schmerzhaften Reize werden dabei nur in beschränktem Ausmaß verabreicht und sind von sehr kurzer Dauer (ca. 1,5 Sekunden). Es können in manchen Fällen leichte Hautirritationen und Rötungen, in seltenen Fällen auch eine minimale Bläschenbildung vorkommen, die jedoch nach kurzer Zeit wieder abklingen. Weitere Nebenwirkungen und Risiken sind keine bekannt.

5. Wann wird die Studie vorzeitig beendet?

Sie können jederzeit, auch ohne Angabe von Gründen, Ihre Teilnahmebereitschaft widerrufen und aus der Studie ausscheiden, ohne dass Ihnen dadurch irgendwelche Nachteile entstehen.

Es ist aber auch möglich, dass Ihr Versuchsleiter entscheidet, Ihre Teilnahme an der Studie vorzeitig zu beenden, ohne vorher Ihr Einverständnis einzuholen. Die Gründe hierfür können sein:

a) Sie können den Erfordernissen der Studie nicht entsprechen;
b) Der Versuchsleiter hat den Eindruck, dass eine weitere Teilnahme an der Studie nicht in Ihrem Interesse ist;

6. In welcher Weise werden die im Rahmen dieser Studie gesammelten Daten verwendet?

Datenschutz

Während des Experiments sind Sie über eine Webcam mit einem der beiden anderen TeilnehmerInnen verbunden. Um Ihre Anonymität und die der anderen TeilnehmerInnen zu gewährleisten, werden Sie zu Beginn des Experiments farbige Kittel zum Überziehen bekommen, damit Ihre persönliche Kleidung nicht sichtbar ist. Zudem wird die Webcam so eingestellt, dass nur Ihr Oberkörper und Ihre Hände für die anderen sichtbar sind. Sie werden die beiden anderen TeilnehmerInnen zu keiner Zeit während oder nach dem Experiment kennen lernen, noch etwas über ihre Identität erfahren. Ebenso werden die anderen TeilnehmerInnen nichts über Ihre Identität erfahren.

Das über die Webcam gesammelte Bildmaterial von Ihnen und den anderen TeilnehmerInnen wird zum Zweck der Datenanalyse aufgezeichnet. Um Ihre Privatsphäre zu gewährleisten, wird das Bildmaterial anonymisiert. Es haben nur die VersuchsleiterInnen und deren MitarbeiterInnen Zugang zu den vertraulichen Daten, in denen Sie namentlich genannt werden. Diese Personen unterliegen der Schweigepflicht. Diese Daten werden zum ehest möglichen Zeitpunkt anonymisiert. Das Bildmaterial wird ausschließlich für die Analyse der Daten herangezogen, und in keiner Weise veröffentlicht oder an Dritte weitergegeben.

Die Weitergabe der Daten erfolgt ausschließlich zu statistischen Zwecken und **Sie werden darin ausnahmslos nicht namentlich genannt**. Auch in etwaigen Veröffentlichungen der Daten dieser Studie werden Sie nicht namentlich genannt.

7. Gibt es einen Kostenersatz oder eine Vergütung?

Durch Ihre Teilnahme an dieser Studie entstehen für Sie keine zusätzlichen Kosten. Als Vergütung für Ihren Zeitaufwand erhalten Sie nach ihrer Teilnahme einen fixen Betrag von € 15,-. Bei einem vorzeitigen Abbruch der Studie, aus welchen Gründen auch immer, erhalten Sie eine Entschädigung für Ihren Anreiseaufwand (4,- Euro).

8. Möglichkeit zur Diskussion weiterer Fragen

Für weitere Fragen im Zusammenhang mit dieser Studie steht Ihnen die Studienleitung gern zur Verfügung. Auch Fragen, die Ihre Rechte als Proband in dieser Studie betreffen, werden Ihnen gerne beantwortet.

Name der Kontaktperson: Univ.-Prof. Dr. Claus Lamm
Erreichbar unter (Bürozeiten): (0043) 01 4277 47130

Name der Kontaktperson: Dr. Jasminka Majdandžić
Erreichbar unter (Bürozeiten): (0043) 01 4277 47132

Name der Kontaktperson: Mag. Birgit Rauchbauer
Erreichbar unter (Bürozeiten): (0043) 01 4277 47131

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9. Einwilligungserklärung

Bitte lesen Sie dieses Formular sorgfältig durch und fragen Sie, wenn Sie etwas wissen möchten oder nicht verstehen.

Name des/der Probanden in Druckbuchstaben: ....

Geb.Datum: .... Code: ....

Ich erkläre mich bereit, an der Studie „Einfluss von spontanen versus vorgegebenen Bewegungen auf Schmerzempfinden und Schmerzbeurteilungsfähigkeit in einem online Gruppensetting" teilzunehmen.

Ich bin von Frau / Herrn .... ausführlich und verständlich über die Studie informiert worden. Ich bin über mögliche Belastungen und Risiken, sowie über Wesen, Bedeutung und Tragweite der Studie als auch sich für mich daraus ergebenden Anforderungen aufgeklärt worden. Ich habe darüber hinaus den Text dieser Probandenaufklärung und Einwilligungserklärung, die insgesamt Seiten umfasst, sorgfältig gelesen. Aufgetretene Fragen wurden mir vom / von der VersuchsleiterIn und/oder dessen / deren MitarbeiterInnen verständlich und genügend beantwortet. Ich hatte ausreichend Zeit, mich zu entscheiden. Ich habe zurzeit keine weiteren Fragen mehr.

Ich werde den Anordnungen, die für die Durchführung der Studie erforderlich sind, Folge leisten, behalte mir jedoch das Recht vor, meine freiwillige Mitwirkung jederzeit zu beenden, ohne dass mir daraus Nachteile entstehen. Ich bin zugleich damit einverstanden, dass meine, im Rahmen dieser Studie ermittelten, Daten aufgezeichnet werden. Um die Richtigkeit der Datenaufzeichnung zu überprüfen, dürfen Beauftragte des Auftraggebers und der zuständigen Behörden bei der Studienleiterin Einblick in meine personenbezogenen Daten nehmen. Beim Umgang mit den Daten werden die Bestimmungen des Datenschutzgesetzes beachtet.

Eine Kopie dieser Probandeninformation und Einwilligungserklärung habe ich erhalten. Das Original verbleibt bei der Studienleiterin.

....
(Datum und Unterschrift des Probanden)

....
(Datum, Name und Unterschrift des verantwortlichen Versuchsleiters)

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D.3 Debriefing Questionnaire

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Versuchspersonennummer: _________
Farbe: _______________

Liebe(r) TeilnehmerIn,

Vielen Dank, dass Sie an unserem Experiment teilgenommen haben!
Ihre Meinung ist uns sehr wichtig, deshalb bitten wir Sie sich noch kurz Zeit zu nehmen ein paar Fragen zu beantworten.
Bitte antworten Sie ehrlich und spontan, es ist uns wichtig zu wissen, was Sie über das Experiment denken, wie Ihre Eindrücke waren, welche Kritikpunkt Sie haben. Durch Ihre Mithilfe können wir das Experiment weiter optimieren.

1. Was war, Ihrer Meinung nach, der Zweck der Studie, die Fragestellung die verfolgt wurde?

A. Fragen über die Joystickaufgabe

2. Ist Ihnen in dem Joystick-Spiel etwas Besonderes aufgefallen (z.B. am Bewegungsablauf der anderen Spieler, ihrem Verhalten, ein Muster in ihren Entscheidungen oder Bewegungen, usw.)?

3. Haben Sie während der Joystickaufgabe in irgendeiner Weise auf die Entscheidungen oder Bewegungen der anderen reagiert?

4. Hatten Sie das Gefühl, dass die anderen beiden in einer besonderen Weise auf Ihre Bewegungen reagierten – z.B. dass einer der beiden seine/ihre Entscheidungen oder Bewegungen an Sie angepasst hat?

5. Hat sich einer der beiden anderen SpielerInnen sich während der Joystickaufgabe **gleich** bewegt wie Sie? ________________

Wenn ja, welcher der beiden (rot, blau oder gelb?) __________________________

Wenn ja, bitte geben Sie genau an wie das Verhalten der SpielerIn Ihrer ähnlich war.

B. <u>Fragen über die erste Schmerzbeurteilungsaufgabe</u>

6. Wie schmerzhaft fanden Sie die eigenen Stimulationsreize?

7. Wie war es für Sie die Schmerzen der anderen in der ersten Stimulationsaufgabe zu beurteilen und Ihre eigenen Gefühle zu bewerten? Ist Ihnen das leicht gefallen oder schwer?

C. <u>Falls Sie selektiert wurden um Schmerzreize abzunehmen/abzugeben</u>:

8. Wie haben Sie die Aufgabe erlebt, in der Sie den anderen Personen einen Teil der zugewiesenen Schmerzreize abnehmen bzw. abgeben konnten? Bitte schildern Sie uns ganz offen Ihre Eindrücke.

9. *[Nur ausfüllen wenn Sie den anderen Personen einen Teil ihrer Schmerzreize abgenommen haben]:*
   Wem haben Sie mehr Schmerzreize abgenommen und warum?

10. *[Nur ausfüllen wenn Sie den anderen Personen einen Teil ihrer eigenen Schmerzreize abgegeben haben]:*
    Wem haben Sie mehr Schmerzreize abgegeben und warum?

D. Fragen über die zweite Schmerzbeurteilungsaufgabe

11. Wie haben Sie die zweite Schmerzbeurteilungsaufgabe, in denen Sie und die anderen Spieler die individuell bestimmte Anzahl von weiteren Schmerzreizen erhielten, erlebt?

E. <u>Allgemeine Fragen zum Versuchsablauf</u>:

11. Wir hatten überlegt alle TeilnehmerInnen in einen Raum zu setzen, haben uns aber aus Gründen der Anonymität dazu entschieden sie in separaten Räumen unterzubringen. Meinen Sie es hätte Sie in irgendeinem der Tasks beeinflusst wenn Sie mit den anderen in demselben Raum gesessen wären? Wenn ja, wie?

12. Da die anderen TeilnehmerInnen nicht im selben Raum waren wie Sie, hatten Sie jemals Zweifel, ob es die anderen wirklich gibt bzw. ob die online Interaktion echt war?

13. Ist Ihnen an dem Versuchsablauf sonst etwas Ungewöhnliches oder „Komisches“ aufgefallen?

Vielen Dank für Ihre Teilnahme!

D.4 Instructions for the joystick task

Joystickspiel

Bei diesem Spiel ist es Ihre Aufgabe, nach jedem Hinweisreiz spontan zu bestimmen, ob sie eine Joystickbewegung ausführen oder nicht.

Über eine Webcam sind sie während der gesamten Zeit mit den anderen beiden TeilnehmerInnen in Ihrer Gruppe verbunden. Sie werden die anderen TeilnehmerInnen abwechselnd auf Ihrem Bildschirm sehen. Ebenso werden die beiden anderen TeilnehmerInnen Sie sehen, und zwar während Sie auf das Startsignal warten, sowie wenn Sie (Ihrer Entscheidung gemäß) den Joystick bewegen oder nicht bewegen.

*** Bitte drücken Sie die Leertaste um fortzufahren ***

Ihre Aufgabe ist es, bei jedem Durchgang sobald sie das Startsignal GO? sehen, spontan zu entscheiden, ob Sie den Joystick bewegen oder nicht, und wenn Sie sich für eine Joystickbewegung entscheiden, ob Sie diese nach links oder nach rechts ausführen.
Ein Durchgang läuft wie folgt ab:

1. Sie warten auf das Startsignal. Währenddessen sehen Sie eine der anderen Personen die ebenfalls auf das Startsignal wartet. Ebenso wird die andere Person Sie in der Warteposition sehen.
2. Sobald das Startsignal GO? erscheint, machen Sie je nach dem was Sie entscheiden entweder gar keine Bewegung, oder möglichst schnell eine Joystickbewegung nach links oder nach rechts. Sie müssen sich dafür sehr schnell (innerhalb von Sekunden) entscheiden.
3. Nachdem Sie Ihre Entscheidung getroffen und die eventuelle Bewegung ausgeführt haben, werden Sie auch die Bewegungsentscheidung der anderen Person, bedingt durch die online-Übertragung etwas zeitverzögert, sehen. Ebenso wird die andere Person Sie sehen.

*** Bitte drücken Sie die Leertaste um fortzufahren ***

Bitte beachten Sie:

- Sie müssen den Joystick immer mit **beiden Händen** bewegen. Lassen Sie dazu immer beide Hände am Joystick, auch wenn Sie ihn nicht bewegen.
- Wenn Sie sich entscheiden den Joystick zu bewegen, dürfen Sie nur Bewegungen nach **links** oder **rechts** ausführen. Bewegungen des Joysticks nach vorne oder nach hinten werden nicht registriert, und der Durchgang fällt aus.
- Entscheiden Sie bitte spontan und rasch nach jedem GO-Signal, ob und in welche Richtung Sie den Joystick bewegen wollen. Da wir sowohl an Durchgängen mit als auch ohne Bewegungsausführung interessiert sind, möchten wir Sie bitten, beide Optionen (bewegen oder nicht bewegen) und Bewegungsrichtungen (links oder rechts) **ungefähr gleich oft** zu wählen.
- Um den Ablauf des Experiments nicht zu stören bitten wir Sie, in keiner Weise (durch Handzeichen, etc….) zu versuchen mit Ihrem Gegenüber Kontakt aufzunehmen. Sollte die Studie aus diesem Grund abgebrochen werden müssen, dann können wir leider nur die Aufwandsspesen (4 Euro) ausbezahlen.

*** Bitte drücken Sie die Leertaste um fortzufahren ***

Probedurchgänge

Um das Bewegen des Joysticks zu üben, folgen jetzt ein Paar Probedurchgänge. Dabei sind Sie noch nicht mit den beiden anderen Spielern verbunden. Sie sehen also nur das GO-Signal und noch keine Webcam-Bilder.

Bitte halten Sie **beide Hände** auf dem Joystick. Sobald ein GO-Signal gezeigt wird, sollen Sie den Joystick nach rechts oder nach links bewegen. Danach erhalten sie Feedback über Ihre Bewegung.

*** Drücken Sie die Leertaste um mit den Probedurchgängen anzufangen***

D.5 Instructions for the empathy task

Schmerzbeurteilungsaufgabe

Im diesem Teil der Studie erheben wir ihr Schmerzempfinden in Reaktion auf elektrische Reize. Auch erheben wir, wie Sie die Schmerzen der anderen Teilnehmer einschätzen, und was Sie selbst fühlen, während die anderen Spieler die Schmerzreize erhalten.

Wie bei der Joysticksaufgabe werden Sie und die anderen TeilnehmerInnen voneinander nur den Oberkörper in den färbigen Kitteln und die Hände sehen.

Sie und die anderen Teilnehmerinnen werden in vier Blöcken Stimulationsreize erhalten. In einem Block werden den TeilnehmerInnen entweder nur **schmerzhafte** oder nur **nicht-schmerzhafte** Stimulationsreize verabreicht. Dies wird am Anfang jedes Blocks angekündigt.

Während mancher Durchgänge werden Sie zudem ein **kurzes, lautes Geräusch** hören. Dieses Geräusch ist für Ihre Aufgabe aber nicht relevant.

*** Bitte drücken Sie die Leertaste um fortzufahren ***

Bei jedem Durchgang erscheint kurz vor der Stimulation ein Blitz am Schirm. Sobald sich die Farbe des Blitzes ändert, wird der Stimulationsreiz verabreicht. Dabei zeigt die Farbe der Blitze an, ob der Reiz schmerzhaft oder nicht-schmerzhaft ist:

Nicht-schmerzhafte Reize

 kündigt eine nicht-schmerzhafte Stimulation an.

 zeigt die tatsächliche Stimulation an. Die Dauer der Stimulation entspricht der Dauer des grünen Leuchtens.

Schmerzhafte Reize

 kündigt eine schmerzhafte Stimulation an.

 zeigt die tatsächliche Stimulation an. Die Dauer der Stimulation entspricht der Dauer des roten Leuchtens.

In Durchgängen in denen Sie selbst einen Reiz erhalten ändert sich die Farbe des LED-Lämpchens neben Ihrer Hand auf gleiche Weise wie die der Blitze am Schirm.

*** Bitte drücken Sie die Leertaste um fortzufahren ***

Bewertungen

Am Ende jedes Blocks bitten wir Sie Ihr Empfinden der Stimulation, die Ihnen oder einer der anderen Teilnehmerinnen in diesem Block verabreicht wurde, auf einer Skala anzugeben.

- Dabei geht es in manchen Fällen um Ihre Einschätzung der **Gefühle der anderen Person**, z.B.
  - *„Wie schmerzhaft waren die Stimulationsreize für die Person?“*
- In anderen Fällen geht es um das Bewerten Ihrer **eigenen Gefühle**, z.B. bei den eigenen Reizen:
  - *„Wie schmerzhaft waren die eigenen Stimulationsreize?' “*
  - *„Wie belastet fühlten Sie sich während der eigenen Stimulationsreize?“*

  oder bei Stimulation der anderen Person:
  - *'Wie unangenehm war es für Sie, die Stimulationsreize mitzufühlen?“*
  - *„Wie belastet fühlten Sie sich während die Person die Stimulationsreize erhalten hat?“*
  - *„Wie mitfühlend fühlten Sie sich während die Person die Stimulationsreize erhalten hat?“*

Mit „**belastet**“ wird gemeint: ein selbstbezogenes Gefühl, das zwar durch die Stimulation der anderen Person entstehen kann, aber das abgetrennt von den Gefühlen der anderen bleibt.

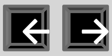
Mit „**mitfühlend**“ wird gemeint: das Gefühl das bei Ihnen entsteht wenn Sie mit ihrem Empfinden bei der anderen Person sind, und deren Gefühle „miterleben“.

*** Bitte drücken Sie die Leertaste um fortzufahren ***

Bewertungen

Für Ihre Bewertungen verwenden Sie eine Skala, die von „gar nicht“ (ganz links) bis „sehr“ (ganz rechts) geht.

- Verwenden Sie bitte die **Pfeil-nach-links-** und **Pfeil-nach-rechts-**Tasten der Tastatur, um Ihre Bewertung auf der Skala einzugeben



- Bestätigen Sie danach Ihre Eingabe mit dem **Pfeil, der nach oben zeigt**.

Bei den Bewertungen ist vor allem Ihre unmittelbare, intuitive Antwort von Interesse: es gibt keine richtigen oder falschen Antworten! Bitte geben Sie ihre Antwort innerhalb von 5 Sekunden ein.

Ihre Eingaben sind anonym, auch die anderen TeilnehmerInnen werden Ihre Bewertungen nicht sehen.

Nach der Schmerzbeurteilungsaufgabe folgen noch einige weitere Aufgaben, über die Sie dann nähere Instruktionen erhalten.

*** Bitte drücken Sie die Leertaste um fortzufahren ***

D.6 Instructions for the prosocial task

Glücksspiel

Später wird Ihnen und den anderen TeilnehmerInnen nochmals je eine Serien von maximal 12 weiteren Schmerzreizen verabreicht. Durch das Spielen des Glücksspiels kann jeder Spieler für sich die Anzahl von Reizen verringern.

Das Glücksspiel läuft wie folgt ab: Bei jedem Durchgang erscheinen am Schirm zwei Zeichen, zB:

Sie müssen sich für entweder das linke oder das rechte Zeichen entscheiden.

- Um das linke Zeichen auszuwählen, drücken Sie die Taste mit dem Pfeil der nach Links zeigt:
- Um das rechte Zeichen auszuwählen, drücken Sie die Taste mit dem Pfeil der nach Rechts zeigt:

Unmittelbar nach Ihrer Entscheidung sehen Sie, ob Sie mit Ihrer Entscheidung gewonnen haben oder nicht. Für jeden Gewinndurchgang wird die Anzahl von 12 Stimulationsreizen mit 1 Reiz zurückgebracht.

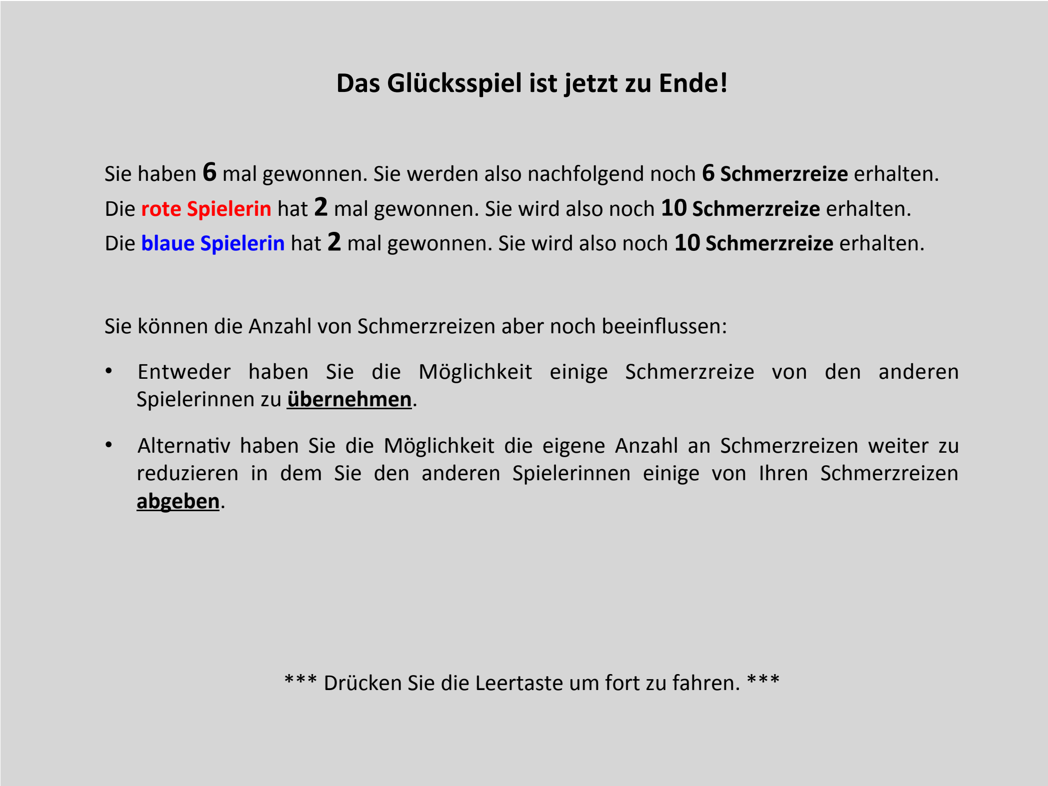
*** Drücken Sie die Leertaste um fortzufahren ***

Die beiden anderen Spieler werden gleichzeitig dasselbe Spiel spielen wie Sie. Bei jedem Durchgang spielt, der Reihe nach, ein anderer Spieler. Dabei werden Sie jeweils auch die Entscheidungen und deren Ergebnisse (Gewinn oder nicht) der anderen Spieler sehen. Ebenfalls können die beiden anderen Spieler Ihre Entscheidungen und deren Ergebnisse sehen.

Am Ende des Spiels werden für jeden Spieler die gewonnenen Durchgänge zusammengezählt, und so die Anzahl von verbleibenden Schmerzreizen bestimmt.

*** Drücken Sie die Leertaste um mit dem Glücksspiel anzufangen ***


Das Glücksspiel ist jetzt zu Ende!
Sie haben 6 mal gewonnen. Sie werden also nachfolgend noch 6 Schmerzreize erhalten.
Die rote Spielerin hat 2 mal gewonnen. Sie wird also noch 10 Schmerzreize erhalten.
Die blaue Spielerin hat 2 mal gewonnen. Sie wird also noch 10 Schmerzreize erhalten.
*** Drücken Sie die Leertaste um fort zu fahren. ***


Das Glücksspiel ist jetzt zu Ende!
Sie haben 6 mal gewonnen. Sie werden also nachfolgend noch 6 Schmerzreize erhalten.
Die rote Spielerin hat 2 mal gewonnen. Sie wird also noch 10 Schmerzreize erhalten.
Die blaue Spielerin hat 2 mal gewonnen. Sie wird also noch 10 Schmerzreize erhalten.
Sie können die Anzahl von Schmerzreizen aber noch beeinflussen:
• Entweder haben Sie die Möglichkeit einige Schmerzreize von den anderen Spielerinnen zu übernehmen.
• Alternativ haben Sie die Möglichkeit die eigene Anzahl an Schmerzreizen weiter zu reduzieren in dem Sie den anderen Spielerinnen einige von Ihren Schmerzreizen abgeben.
*** Drücken Sie die Leertaste um fort zu fahren. ***

Appendix E

E. Curriculum Vitae

PERSONAL DETAILS

Name	Marina Maksimova
Place and Date of Birth	St. Petersburg, 02nd April 1988
Address	Schönburgstr. 40/6, 1040 Vienna, Austria
Telephone	+43 676 3917172
E-Mail	marina.maksimova.v@gmail.com

EDUCATION

since 10/2008	Diploma program Psychology, University of Vienna, Austria
2011-2012	Non-EU Study Exchange at the Université de Montréal, Canada. Master's program: Psychology
2002-2008	Highschool "Gymnasium an der Gartenstraße", class with bilingual program English, Mönchengladbach, Germany. School-leaving certificate: Abitur
1997-2002	Highschool "Rudolf-Steiner-Schule", Mönchengladbach, Germany
1995-1997	Primary school "Rudolf-Steiner-Schule", St. Petersburg, Russia

INTERNSHIPS

02/2013-07/2013	Internship at the General Hospital Vienna, Department of Pediatrics and Adolescent Medicine, Division of Neuropediatrics, Austria
09/2012-10/2012	Internship at the Neurological Rehabilitation Center Rosenhügel (NRZ), Division of Neuropsychology, Austria
07/2010-08/2010	Internship at the Max-Planck-Institute for Evolutionary Anthropology, Department of Developmental and Comparative Psychology (Prof. Dr. Michael Tomasello), Leipzig, Germany
05/2008-05/2008	Internship at the Center for Speech Therapy Christina Kolb, Mönchengladbach, Germany

PROFESSIONAL EXPERIENCE

02/2014-11/2014	Assistant at the International Office, University of Vienna, Austria. Field of Responsibility: ERASMUS Incoming Students, Non-EU Exchange Outgoing Students.
11/2010-09/2014	Cashier at the Bookshop Thalia GmbH, Vienna, Austria.
2009-2010	Promotion at Easystaff GmbH, Vienna, Austria
2008-2010	Service employee at PERSONALIS GmbH, Vienna, Austria
06/2008-08/2008	Cashier at Disneyland Ressort Paris, France
06/2007-07/2007	Child care at summer camp FIT Jugendreisen GmbH, Castelfusano, Italy

VOLUNTARY WORK

03/2014-09/2014	Clinic nanny at St. Anna Children's Hospital Vienna, Division of Pediatric Oncology, Austria
07/2014-08/2014	Child care at summer camp Kinderfreunde Lenzing, Bad Hall, Austria
2010-2011	Erasmus Student Network (ESN), section: University of Vienna. Fields of responsibility: event management, help and support of incoming exchange students, office hours. Austria
07/2009-07/2009	International Work Camp, La Rioja, and university summer course „Paleoicnología y Restauración de Huellas de Dinosaurios“ der Universidad de La Rioja, Spain

LANGUAGE SKILLS

Russian (mother tongue), German (fluent), English (fluent), French (fluent), Spanish (basic knowledge)

IT SKILLS

Windows, Linux, MacOS, Microsoft Office, Open Office, Outlook Express, SPSS, MATLAB (eeglab), i3V, Typo3