A Grounded Approach to Psychological Perspective-Taking

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Introduction

> I may seem to be passionately concerned with the ‘hows’ of representation, how you actually represent rather than ‘what’ or ‘why’. But to me this is inevitable. The 'how' has a great effect on what we see. To say that 'what we see' is more important than 'how we see it' is to think that 'how' has been settled and fixed. When you realize this is not the case, you realize that 'how' often affects 'what' we see. (Hockney, 1993, p. 128)

As the famous British artist David Hockney beautifully describes in his biography, he spent a lifetime fighting against the limitations of various artistic means of representation. A classical painter, Hockney also turned to stage design, photography, and printing as well as other ways of digital reproduction whenever he felt that a prior artistic medium failed as an abstraction of the concept he wanted to represent. There is a trivial wisdom to his behavior: the format chosen for the presentation of a piece of art will affect its reception – there is a difference between painting and modelling. As an artist you want to exhibit the research you have done and the artistic solution you found to approach it. This is why Hockney frequently changed the predominant “how” in his works.

However, this hardly captures the core of his quotation. The quote is not as much about active presentation as it is about passive reception. Note that Hockney in the third sentence changes from the singular “I” to speaking of “we”, of all human beings. Although he as an artist certainly limits the way “we” as the audience approach his art by choosing a certain medium, there is still ample room for individual interpretation. Even objectively the same piece of art can evoke a wide range of responses by different audiences. This is why the “how” is never settled and fixed and determines “what” the exhibition-goer and even the artist himself sees in a given piece of art. This is why the “how” indeed can be more important than the “what”.

The notion that how we approach something affects what we take from it is by no means limited to the arts. It is, for instance, the basic assumption of Heisenberg's *uncertainty principle* (Heisenberg, 1927, 1930) which states that the precision with which we assess two complementary parameters of one and the same system is limited by the respective other. An often used example are the position and the momentum of a particle. The more precise we measure the particle's speed, the less precise we can measure its position and vice versa. Similarly the *observer* or *experimenter effect* (which is often confused with the Heisenberg principle) states that merely any observation of a system changes measurement outcomes. A famous example of this is the thought experiment of Schrödinger's cat (Schrödinger, 1935). Both of these phenomena also come close to the idea that how (or the fact that) we look at objectively the same thing affects what we find out about it.

Given the numerous instances where psychological impressions of the same situation mismatch, this principle seems to extend to human psychology as well. A sarcastic statement can humor us and offend us. We can fail to see why our friends are overjoyed with their newborn child that cries all the time and steals their sleep. We all have bumped into other people on a busy sidewalk because we misunderstood the simple statement "I'll go left". The psychological principle behind all of these instances – artistic, physical, and psychological – is the concept of reference frames. We inevitably bring own properties to bear in every situation and this determines our default egocentric frame of reference of that given situation. Therefore "how" a situation is construed by necessity differs fundamentally between two people and consequently the "what" differs more often than not as well.

Luckily humans are not slaves to their egocentrism. In contrast to all other animals we are capable of changing our frame of reference. A famous example for this from psychological research is the framing of an objectively identical situation in terms of gains or losses which strongly impacts decision-making (see, e.g., A. Tversky & Kahneman, 1981). But such framing effects span all areas of human judgment and generally, the ability to de-center, to overcome our egocentric frame of reference, is called “perspective-taking”. People are capable of taking different cognitive, emotional, and visual perspectives. For instance, we are able to understand that other people lack or have privileged information (Wimmer & Perner, 1983), we have a theory of mind (Premack & Woodruff, 1978) which helps us understand a sarcastic comment the right way. We are capable of empathy (Batson, 2009; Davis, 1994), of understanding that having a child is a joyous occasion for its parents although it seems stressful to us. Finally, we are able to imagine that the world looks different for someone else (Michelon & Zacks, 2006; Zacks & Michelon, 2005) and therefore we anticipate that a pedestrian actually goes to our right when he says “I’ll go left” and we can successfully avoid bumping into him (cf. Kessler & Thomson, 2010).

If the “how” can indeed trump the “what”, then this obviously raises the question of how we are able to do this. Despite the functional similarity between all kinds of perspective-taking, this question has been answered very differently across research areas. As a matter of fact, it is fair to say that whereas cognitive and emotional perspective-taking researchers strongly focused on the “what” question, perceptual perspective-taking researchers focused most strongly on the “how” and both have rarely been combined up until now. Nowadays, the fields even consider different kinds of perspective-taking as independent and different from each other although there is no adequate evidence for this distinction (but see Fiske, Taylor, Etcoff, & Laufer, 1979; Libby & Eibach, 2011b).

The main consequence (i.e., the “what”) of cognitive and emotional perspective-taking is a feeling of oneness, a conceptual merging between the self and the perspective-taking target (Batson, Sager, et al., 1997; Davis, Conklin, Smith, & Luce, 1996; Davis et al., 2004; Galinsky & Ku, 2004; Galinsky, Ku, & Wang, 2005; Galinsky & Moskowitz, 2000). However, the processes (i.e., the “how”) which lead up to this feeling of oneness are largely unknown and researchers are mostly concerned with external factors that influence this basic faculty of what is called “psychological perspective-taking”.

Perceptual perspective-taking research, on the other hand, has shown that different perspectives are represented as our own egocentric perspective of an object from a different spatial location (Flavell, 1968, 2000; Flavell, Everett, Croft, & Flavell, 1981; Huttenlocher & Presson, 1973, 1979; Koriat & Norman, 1984; Roberts & Aman, 1993). Adults achieve this by means of a mental rotation of their body schema into another person's position (Kessler & Rutherford, 2010; Kessler & Thomson, 2010; Kessler & Wang, 2012; Surtees, Apperly, & Samson, 2013a, 2013b) – they literally put themselves in another's place. Although this clearly answers the "how" question, the effects (i.e., the "what") following this own-body-transformation are largely neglected in this area.

Three open questions in perspective-taking research therefore are, first, whether different kinds of perspective-taking are independent or related. Second, how do we take the psychological perspective of somebody else? And third, what are the consequences of purely perceptual perspective-taking? The mere fact that the "how" and the "what" questions have never been combined within these two fields of research offers a very elegant solution to all three questions which is founded on the embodied or grounded cognition framework. This theory argues that psychological meaning is grounded in perceptual and motor experiences (Barsalou, 1999, 2008) and therefore would concur that visually looking at a scene from different angles can indeed also affect our thoughts and feelings about it. More specifically, the mental body rotation during perceptual perspective-taking can cause further psychological (i.e., cognitive and affective) consequences, too.

The present thesis takes a grounded and unifying approach to perspective-taking. In the introduction the literatures on both perceptual and psychological perspective-taking are summarized with a special focus on the questions of how we adopt other perspectives and what that does to our own psychology. Based on this, a grounded view of psychological perspective-taking is proposed and the idea that changes in visuo-spatial perspectives can lead to psychological consequences is directly and adequately tested in six experiments.

Theoretical Part

Although currently not very prominent, the idea that visual perspectives might influence the psychological state of a person is not exclusive to the arts or natural sciences. Especially in psychological research there have been debates about a potential relation between visual perspectives and so-called “psychological perspectives”. Specifically research on perspective-taking has repeatedly approached the hypothesis proposed by Hockney in the introduction.

Early researchers defined perspective-taking as a “multidimensional social-cognitive skill” (Kurdek, 1978, p. 6; see also Underwood & Moore, 1982), serving the purpose of overcoming one’s own egocentrism (Ford, 1979) to “entertain a different point of view” (Davis, 1994, p. 47). They also recognized that this process operates on multiple contents. For instance, one can imagine how another person thinks about, feels towards, or looks at something – all of which should be considered a form of perspective-taking. Although occasionally other kinds of perspective-taking are mentioned (e.g., moral perspective-taking in Hogan, 1969; Underwood & Moore, 1982), the most prominent kinds are *perceptual*, *cognitive*, and *affective* (see, e.g., Davis, 1994; Enright & Lapsley, 1980; Ford, 1979; Krebs & Russell, 1981).

Perspective-taking plays an important role in multiple research areas and under different labels. For instance, cognitive and perceptual perspective-taking are often linked to theory of mind, and affective perspective-taking often relates to the concept of empathy. Both empathy and theory of mind are large research topics in their own right, which underlines the importance of perspective-taking in human social cognition. However, this dispersion of perspective-taking over multiple independent research areas also spurred the debate whether it should be considered a unitary process or an ensemble of multiple different processes.

Unitary and Segregated Definitions of Perspective-taking

A unitary view of perspective-taking holds that although concerned with different contents, all kinds of perspective-taking still are strongly interrelated and draw on overlapping processes (Kurdek, 1978; Underwood & Moore, 1982). For instance, regardless of whether one engages in cognitive, affective, or perceptual perspective-taking, one needs to bridge the gap between an intrinsically egocentric and a to-be-taken, a so-called allocentric, frame of reference. What differs is merely the referential content of this otherwise identical operation. Interestingly, such a connection between different kinds of perspective-taking is also evident in everyday language. For instance, also when talking about cognitive or affective perspective-taking people inevitably use spatial locatives (e.g., “understand my point of view”, “put yourself in my place” or “look at this from my side”). This conceptual metaphor indicates that the visual representation of a perspective might be a core element of experiencing cognitive and affective perspectives, too (cf. Lakoff & Johnson, 1980).

In spite of these structural and linguistic similarities unitary accounts of perspective-taking have ever been in competition with segregated views of the construct. These accounts ignore the abovementioned conceptual and linguistic similarities between different kinds of perspective-taking and put greater emphasis on measurement-related differences between them. Therefore, a segregated view would hold that there are three independent processes – namely cognitive, affective, and perceptual perspective-taking – which share nothing but their name. The strongest argument for these views is that early measures of perspective-taking were very specific as to which kind they assessed. For instance, in the well-known three mountains task by Piaget and Inhelder (1956), young children get to know a set of three differentiable mountains. Subsequently, a doll is put on one of these mountains so that it has a different vantage point than the child. Children then are shown pictures and asked to indicate which picture corresponds to the doll’s point of view. This task can obviously assess perceptual perspective-taking but neither of the other two forms. Similarly, privileged information paradigms such as the apple-dog story (cf. Flavell, 1968), false-belief (e.g., Wimmer & Perner, 1983), or other related tasks (e.g., Feffer & Gourevitch, 1960) are useful only for assessing cognitive perspective-taking abilities. In these tasks children get to know all information about a story (thus they have “privileged information”). The characters in the story, on the other hand, lack some information. Children are specifically asked for information that they possess but the characters in the story lack. These tasks measure the ability to know that mental states of other people can differ from their own. To solve the task correctly, children have to imagine a different cognitive perspective. Finally, early affective perspective-taking tasks (e.g., Borke, 1971; Burns & Cavey, 1957; Mehrabian & Epstein, 1972) were yet more specific which made even comparisons within this domain problematic and questioned the construct validity of affective perspective-taking in general (cf. Enright & Lapsley, 1980).

Currently, predominant theories summarize only cognitive and affective perspective-taking (see, e.g., Batson, 2009; Blair, 2005; Bzdok et al., 2012; Duan & Hill, 1996; Shamay-Tsoory, 2011a) under the overarching term “psychological perspective-taking” (Epley & Caruso, 2009; Epley, Keysar, Van Boven, & Gilovich, 2004; Galinsky & Moskowitz, 2000) and perceptual perspective-taking is isolated from this construct. Following this separation, these two fields of research developed diametrically different. Research on psychological perspective-taking became increasingly concerned with its effects on our thinking and feeling while at the same time paying less attention to the underlying mechanisms of these effects. Research on perceptual perspective-taking, on the other hand, increasingly focused on the underlying mechanisms of the process while neglecting its psychological consequences.

Evidence for Unitary and Segregated Views of Perspective-taking

The abovementioned development begs the question whether the divorce of perceptual and psychological perspective-taking is warranted or whether researchers just adopted two different approaches to study one and the same topic. This question has rarely been approached theoretically, but rather on a purely empirical level. Most often, it was tackled on a correlational level, which is, however, unfeasible to determine how many kinds of perspective-taking exist. The correlational approach usually points to shared variance between two kinds of perspective-taking (e.g., $|r| > 0$, $p < .05$), but the overlap is usually far from perfect (e.g., $|r| < 1$, $p < .05$). The question remains open whether the amount of shared variance is large enough to declare sameness or distinctness of different constructs and declaring that two tasks measure the same construct becomes somewhat exegetic and a correlation of $r = .30$, for instance, can be and has been interpreted as supporting a unitary as well as a segregated view of perspective-taking.

A more preferable method is an experimental approach which identifies a mechanism specific to either kind of perspective-taking. Showing that causally manipulating one construct influences a measure of affective but not cognitive perspective-taking, for instance, would establish the validity of this distinction (Borsboom, Cramer, Kievit, Scholten, & Franic, 2009; Borsboom, Mellenbergh, & van Heerden, 2004). On the flipside, showing that an experimental manipulation of one construct influences two kinds of perspective-taking would convincingly demonstrate that they share one common causal precursor.

Correlational evidence. An early review of the perspective-taking literature found varying relations between different measures of all three kinds of perspective-taking and concluded that therefore, they cannot relate to the same underlying construct (Ford, 1979). Similarly, Johnson (1975) found that cooperation correlates significantly with emotional (affective) but not with physical (perceptual) perspective-taking. Since cooperation involves understanding what the cooperation partner wants, he proposed that perceptual perspective-taking is independent of such mental state representations.

While there seem to be some developmental differences between different types of perspective-taking (Shantz, 1975), the correlational evidence for completely disconnecting them is equivocal. The review by Ford (1979), for instance, actually reports quite substantial positive zero-order and partial correlations between perceptual and affective (*r*s between $r = .36$ and $r = .44$), as well as cognitive (*r*s between $r = -.06$ and $r = .73$) perspective-taking. The correlations between affective and cognitive perspective-taking were rather low in comparison, yet sometimes significant (*r*s between $r = -.23$ and $r = .49$). Importantly, there are many reasons why all of these correlations are low other than the constructs being independent. For instance, the reliabilities of most early measures were insufficient and the sample sizes of most studies were rather small. Furthermore, since they were developed independently, different measures of perspective-taking have very poor conceptual and structural fit (see, e.g., Ajzen & Fishbein, 1977; Payne, Burkley, & Stokes, 2008) which would even reduce the correlation between two measures of exactly the same construct substantially (for a similar argumentation, see Barrett-Lennard, 1981). The evidence of Johnson (1975) is more unequivocal with regards to correlation magnitude but his work refers to a specific context and suffers from a small sample size. Therefore it seems unwise to generalize from the context of cooperation to all kinds of perspective-taking.

Some more recent studies observed a mixed pattern using measures of both psychological and perceptual perspective-taking (Gardner, Sorhus, Edmonds, & Potts, 2012; Mohr, Rowe, & Blanke, 2010). These studies yielded a positive correlation between empathy (affective perspective-taking) and the accuracy in different perceptual perspective-taking tasks, as well as a negative correlation with the speed on these tasks. Furthermore, these correlations were specific to female participants (Gardner et al., 2012; Mohr et al., 2010). These divergent correlations suggest that the relation between affective and perceptual perspective-taking might be more complex than originally assumed. Some recent evidence suggests that this dissociation can be explained by the strategies used during the visuo-spatial task (see below; see also Conson et al., 2015; Erle & Topolinski, 2015; Kessler & Wang, 2012; Nielsen, Slade, Levy, & Holmes, 2015; Pearson, Marsh, Hamilton, & Ropar, 2014; Pearson, Marsh, Ropar, & Hamilton, 2015; Zapf, Glindemann, Vogeley, & Falter, 2015). This difference potentially also underlies the gender effect observed in these studies because women seem to be generally more empathic than men (for reviews, see, e.g., Eisenberg & Lennon, 1983; Lennon & Eisenberg, 1987).

Other studies directly support unitary views of perspective-taking. For instance, some studies found positive correlations between social skills (a construct related to empathic perspective-taking, cf. Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001) and perceptual perspective-taking abilities (Brunyé et al., 2012; Mohr et al., 2010; Shelton, Clements-Stephens, Lam, Pak, & Murray, 2012). In another study two aspects of empathy, empathic concern and empathic perspective-taking (cf. Davis, 1983), also positively correlated with visuo-spatial perspective-taking in women (Thakkar, Brugger, & Park, 2009) and this link was recently generalized to both genders and other measures of spatial ability (Erle & Topolinski, 2015; Gardner, Brazier, Edmonds, & Gronholm, 2013; Gardner & Potts, 2011; Gardner et al., 2012; Gronholm, Flynn, Edmonds, & Gardner, 2012; Mohr, Rowe, Kurokawa, Dendy, & Theodoridou, 2013; Nielsen et al., 2015; Thakkar & Park, 2010).

Albeit also using a correlational approach, the studies by Erle and Topolinski (2015) were the first to base the relation between perceptual and psychological perspective-taking on the assumption of a shared mechanism which is further elaborated and experimentally substantiated in the present thesis. This account hinges on the identification of embodied self-rotation as the central mechanism of visuo-spatial perspective-taking (Kessler & Rutherford, 2010; Kessler & Thomson, 2010; Surtees et al., 2013a, 2013b). Imagining how the world looks for another person involves shifting one's body schema into the target's place. The authors assume that this embodied self-other merging is also involved in simulations of another person's psychological "point of view". In accordance with this assumption, people who do well on spatial ability tests – and specifically those who report using self-other merging during those tests – reported higher empathic perspective-taking, too. In a similar vein, differences on social skills predict how participants solve spatial perspective-taking problems (Kessler & Wang, 2012). Whereas socially skilled people solve these tasks by assuming another person's spatial frame of reference, socially unskilled participants tended to employ non-social, egocentric strategies that do not involve another person (Kessler & Wang, 2012; see also Nielsen et al., 2015). This last finding further underlines potential functional similarities between psychological and perceptual forms of perspective-taking (cf. Erle & Topolinski, 2015): how a person conceives of perceptual/social problems can influence how that person approaches the respective other kind of problem, too.

Research from clinical and developmental psychology, as well as from evolutionary biology also suggest a unitary view of perspective-taking. For example, different populations with deficient empathy (i.e., affective perspective-taking), such as psychopaths (Blair, 2005; Mullins-Nelson, Salekin, & Leistico, 2006), schizophrenic/schizotypic (Thakkar & Park, 2010) patients, and people within the autism-spectrum (Hamilton, Brindley, & Frith, 2009; A. P. Jones, Happé, Gilbert, Burnett, & Viding, 2010) all exhibit deficits in perceptual perspective-taking abilities, too. Children suffering from autism-spectrum disorder do not only differ with regards to their performance on visuo-spatial perspective-taking tasks but also concerning their strategy use. Whereas normally developing children employ an embodied self-transformation strategy, autistic children rely more heavily on other non-embodied mental rotation strategies (see, e.g., Conson et al., 2015; Pearson et al., 2014; Pearson et al., 2015; Zapf et al., 2015). In evolutionary biology it has also long been recognized that empathy and theory of mind (psychological perspective-taking) succeed visuo-spatial (perceptual) perspective-taking, thus indicating that the latter might be an evolutionary stepping stone towards higher forms of mental state representations in other people. Whereas primates and greater apes perform quite well on some perceptual perspective-taking tasks not involving overcoming one’s egocentrism, they fail at perceptual perspective-taking task involving a mental state representation such as imagining how the world looks for a conspecific. Of course they also fail at psychological perspective-taking tasks (Bräuer, Call, & Tomasello, 2005; Call & Tomasello, 2008; Hare, Call, Agnetta, & Tomasello, 2000; Hare, Call, & Tomasello, 2001; Tomasello, Call, & Hare, 1998, 2003; Tomasello, Carpenter, Call, Behne, & Moll, 2005).

Taken together this evidence suggests a link between psychological and perceptual perspective-taking which sometimes is even stronger than the link between the two psychological kinds of perspective-taking. Although historically segregated views have been favored, there is a recent resurgence of correlational findings speaking for a unitary view which is in line with and potentially due to the theory of grounded cognition (Barsalou, 1999, 2008; T. W. Schubert & Semin, 2009) which holds that the representation of abstract concepts is "grounded in" concrete instantiations of these concepts. In this vein, simulations of psychological perspectives could be grounded in their physical, perceptual counterpart or in other words: imagining the psychological state of another person entails a simulation of that person's egocentric visuo-spatial perspective, too.

Experimental evidence. Given the nowadays universal acceptance of segregated views of perceptual and psychological perspective-taking, there is astonishingly little experimental research on the difference between them. One rare exception is an early study by Fiske et al. (1979) which found diverging effects following different perspective-taking instructions. Based on findings that visual attention is related to social perception – the so-called actor-observer-bias (E. E. Jones & Nisbett, 1971) – Fiske et al. (1979) investigated whether instructions to empathize with a target person in a story (affective, i.e., psychological perspective-taking) and instructions to visualize the story from a target person's visual point of view (perceptual perspective-taking) lead to comparable outcomes. They assessed personal attributions about the characters in a story and recall of situational details about that story as a function of the different instructions. Whereas perceptual imagination instructions changed what details of the situation participants recalled but not attributions about the characters in the story; empathizing instructions changed the attributions but not the recalled information of the participants.

Therefore it was concluded that the two kinds of perspective-taking are independent. However, the authors concede in their general discussion that their experimental manipulation was in fact insufficiently capable of differentiating between these kinds and that "the question remains open, that is, whether role-taking in general combines aspects of both imaging and empathy" (p. 374). Indeed, it is a very strong contention to argue that the instructions used for the more psychological kind of perspective-taking such as "take a perspective in a situation", “picture to yourself how somebody feels”, or “in your mind’s eye, visualize clearly and vividly somebody’s reactions in a situation” are not supplemented by any visual input whatsoever.

Nonetheless, this paper serves as the template for modern perspective-taking research in social psychology on “self-distancing” (Ayduk & Kross, 2008, 2010; Kross & Ayduk, 2008, 2009, 2011; Kross, Ayduk, & Mischel, 2005) or the “role of visual perspective in mental imagery” (Libby & Eibach, 2009, 2011a, 2011b, 2013; Libby, Eibach, & Gilovich, 2005; Libby, Shaeffer, & Eibach, 2009; Libby, Shaeffer, Eibach, & Slemmer, 2007; Libby, Valenti, Hines, & Eibach, 2014; Libby, Valenti, Pfent, & Eibach, 2011; Valenti, Libby, & Eibach, 2011). These lines of research extensively demonstrate that imagining events from different visual perspectives changes the way people think or feel about them. Although this might sound like support of a unitary view of perspective-taking, the authors of these studies argue that the underlying processes of perceptual and psychological perspective-taking differ.

Crucially for the present context, these studies use similar manipulations as Fiske et al. (1979) to induce perceptual perspective-taking without acknowledging that these might comprise both perceptual as well as psychological aspects. The visual perspective in mental imagery, for instance, is manipulated to be egocentric using this instruction:

> You should picture the event from a first-person visual perspective. With the first-person visual perspective you see the event from the visual perspective you had when the event was originally occurring. In other words, you can see your surroundings in the event looking through your own eyes (Libby & Eibach, 2011b, p. 189).

The authors rigorously and orthogonally manipulated the visual aspect of the instruction in the allocentric perspective instruction, which reads as follows:

> You should picture the event from a third-person visual perspective. With the third-person visual perspective you see the event from the visual perspective an observer would have had when the event was originally occurring. In other words, you can see yourself in the event as well as your surroundings (Libby & Eibach, 2011b, p. 189).

The methodological rigor of the manipulation notwithstanding, is it reasonable to assume that reconstructing an event from an egocentric compared to an allocentric perspective only involves using a different visual angle? Is the only difference between a speaker at a conference and the audience the way in which they look at the conference room? Imagining giving a talk in front of hundreds of people certainly differs from imagining listening to that talk in many other important ways. Nonetheless the authors state that: “effects involving variation in visual point of view are not equivalent to effects involving variation along other dimensions that may also be commonly referred to as “perspective,” such as empathy (e.g., Davis, 1983), psychological perspective-taking (e.g., Galinsky, Ku, & Wang, 2005), or self-distancing (Ayduk & Kross, 2008).” (Libby & Eibach, 2011b, p. 189; see also pp. 224-226). In spite of this claim, research on empathic perspective-taking actually uses very similar instructions to specifically induce empathic (i.e., psychological and not perceptual) perspective-taking, see, for instance:

> As you watch the interview, please imagine how you *yourself* would feel if you were the person in the tape. Concentrate on the way you would feel if these events were happening to you. Imagine as clearly and vividly as possible everything that *you* would experience. In short, imagine that *you* are actually the person in the videotape. (Davis et al., 2004, p. 1628; emphasis in original).

Again: given the almost identical content of these instructions, is it plausible to assume that the latter entails purely empathic (i.e., psychological) perspective-taking whereas the former involves purely perceptual perspective-taking? Given their similarity and the strong linguistic relation between perceptual and psychological perspective-taking (Lakoff & Johnson, 1980), the answer seems to be no. As a matter of fact, this was already acknowledged more than twenty years ago:

> In a nutshell, the problem is that researchers employing the “imagine-the-self” and “imagine-the-other” instructions […] have generally assumed that observers who are given these instructions do as they are told. […] What is poorly understood, however, is exactly what observers do when attempting to comply with such instructions. […] Thus, while instructional sets […] have been found to produce quite reliable effects on affective and behavioral outcomes, remarkably little is known about the precise cognitive activities which ensue when these instructions are followed. (Davis, 1994, p. 207)

Returning to the initial question whether perspective-taking should be considered unitary or segregated, these experiments are therefore not very useful. Experimental research addressing the question whether psychological and visual perspective-taking involve different mechanisms needs to exclusively manipulate one kind of perspective-taking and prove that this only affects dependent variables of the same kind and not any other kind (Borsboom et al., 2009; Borsboom et al., 2004). Alternatively, it would be possible to establish discriminant validity between constructs if a potentially confounded manipulation exclusively affected measures of only one kind of perspective-taking. For instance, if empathic perspective-taking instructions affected a measure that is not affected by visual perspective-taking instructions, this would support the notion that although these instructions read very similar they in fact instigate different processes. Unfortunately this is often also not the case as the authors acknowledge in this lowly quote: “In some cases, different types of perspective-taking manipulations produce common effects, yet it is still the case that different mechanisms could be at work.” (Libby & Eibach, 2011b, p. 225).

The state of the art therefore can be summarized as such: researchers on both empathic perspective-taking and “visual perspective in mental imagery” claim to manipulate one kind of perspective-taking. Their independent manipulations, however, are very similar, potentially confound visual and psychological simulation aspects, and furthermore affect many dependent measures in parallel (for a rare exception, see Fiske et al., 1979). Manipulating psychological perspective-taking without ever tapping perceptual perspective-taking seems like a dubious proposition at best given the strong metaphorical link between them (Lakoff & Johnson, 1980). Manipulating perceptual perspective-taking independent of psychological perspective-taking, on the other hand, seems comparatively more possible. Indeed, some very early studies went to great lengths to achieve this.

In an ingenious study on the actor-observer-bias by Storms (1973) groups of four participants were recruited. Two were asked to engage in a five minute “getting acquainted” conversation (the so-called “actors”) while the other two were asked to silently observe one of the actors (the so-called “observers”). One actor and one observer each were seated at the same side of a table and opposite of the other two. The scene was videotaped from these two angles, too. The dependent measure of the study was a questionnaire that asked to what degree the actors’ behavior reflected their dispositions or situational influences. Before participants completed this questionnaire, they were told to watch a videotape of the situation because this allegedly improved their ability to judge. The crucial manipulation of the study was that either one or both video cameras “had a malfunction” and only one or no video could be shown.

Therefore, in one condition (the control condition) participants saw no video and the general actor-observer-bias was observed. Actors attributed their behavior to situational influences, whereas observers explained it as reflecting personal dispositions (cf. E. E. Jones & Nisbett, 1971). In a second condition (the same perspective condition) participants watched the video again from their own perspective and also showed an actor-observer-bias. In the critical third condition (the new perspective condition) participants saw the videotape from the respective other perspective. Therefore, actors became observers of their own actions and observers now saw the conversation unfold from the view of the actor who they previously observed. In this condition the actor-observer-bias was reversed. This demonstrates that a purely perceptual shift in perspective causes psychological consequences, too. Usually actors attribute their behavior to the situation whereas observers see it as reflecting personal dispositions (E. E. Jones & Nisbett, 1971). In the new perspective condition, however, actors who subsequently observed their own actions responded like observers. The visual perspective taken in the video hence dominated the original psychological perspective of the participant with regards to the formed judgment (Storms, 1973).

These results were later extended using a psychological perspective-taking manipulation in other studies (Brehm & Aderman, 1977; Galper, 1976; Gould & Sigall, 1977; Regan & Totten, 1975). These studies realized only the observer conditions of Storms (1973) and put great emphasis on keeping the visual input between participants constant while exclusively manipulating psychological perspective-taking. Specifically, these authors had participants watch a standardized video of a getting acquainted situation and told one group of participants to empathize with one person (psychological perspective-taking) whereas the remaining participants were instructed to just observe that person. By providing a videotape of the situation, the visual input that went into participants perspective-taking efforts was matched between conditions while the psychological aspect was experimentally manipulated. The results of these studies are best summarized by Galper (1976, p. 333): “While Storms (1973) has demonstrated that a *literal* change of perspective can systematically affect the attributional biases of actors and observers, the present results demonstrate that a *figurative* “change of perspective" can elicit "actor-like" causal attributions from observers." (emphasis in original). By literal and figurative the authors obviously refer to perceptual and psychological perspective-taking, that is, a psychological manipulation reversed a perceptual effect.

Their methodological rigor notwithstanding, these studies were not framed as perspective-taking research and arguably attributional style is a very distant indicator of perspective-taking. However, given the obvious advantages of their very elaborate and specific manipulations over instructional sets (Batson, Early, & Salvarani, 1997; Davis et al., 2004; Kross & Ayduk, 2011; Libby & Eibach, 2011b; Stotland, 1969), it is almost surprising that such manipulations have not been employed more frequently in perspective-taking research – especially given how readily a segregated view of perspective-taking is taken for granted in recent theorizing (for reviews, see Kross & Ayduk, 2011; Libby & Eibach, 2011b).

Problems of State of the Art Perspective-taking Research

The presently favored semi-segregated view of perceptual versus psychological perspective-taking is largely content-based and not process-based. Researchers merely claim that some measures and manipulations involve psychological perspective-taking whereas others involve perceptual perspective-taking. In order to establish a theory-driven segregated view of perspective-taking, firstly an experiment involving a specific manipulation of any one kind perspective-taking is needed. Such manipulations have been employed for perceptual but not psychological perspective-taking research (see, e.g., Storms, 1973). Secondly, such a manipulation must be combined with specific and adequate measures of perspective-taking. If, for instance, a purely perceptual manipulation of perspective-taking affected a measure of psychological perspective-taking this would strongly favor a unitary view of the construct. If, however, there were no effect on such a dependent measure this would strongly support a segregated view. Thirdly, the mechanisms by which perceptual perspective-taking influences psychological perspective-taking need to be specified. A unitary view of perspective-taking hinges on the assumption of a shared underlying mechanism between the different kinds of perspective-taking (e.g., overcoming one's egocentrism, cf. Ford, 1979). Therefore it is necessary to show that they indeed involve that same mechanism or otherwise also non-perspective-taking-aspects of an experimental manipulation could cause an effect that is then falsely attributed to perspective-taking – much like effects of visual perspective in mental imagery could be caused by psychological aspects, too (cf. Libby & Eibach, 2011b).

The present thesis works towards an experimental paradigm fulfilling all three of these criteria which is therefore specifically designed to adequately test a unitary view of perspective-taking experimentally for the first time. In this vein, the relevant processes underlying all kinds of perspective-taking and their psychological consequences are discussed next.

Psychological Perspective-taking

What social psychologists call psychological perspective-taking summarizes the affective and cognitive sorts. These concepts are relevant for empathy and theory of mind research, too. Although both fields have contributed to the understanding of psychological perspective-taking, they disagree about what cognitive and affective perspective-taking are.

While it was originally introduced by Titchener (1909) just as an English translation for the term *Einfühlung* coined by the German philosopher Theodor Lipps (1903), “the term *empathy* is currently applied to more than a half-dozen phenomena” (Batson, 2009, p. 3; emphasis in original). At the broadest level of definition researchers agree that empathy has a cognitive and an affective component. But there is no generally accepted nomenclature for what exactly cognitive and affective empathy are, how they relate to each other, and consequently where to locate different kinds of perspective-taking. Some researchers have proposed two kinds of empathy (Smith, 2006; Staub, 1987; Wispé, 1968, 1986; Zahn-Waxler, Radke-Yarrow, Wagner, & Chapman, 1992; Zahn-Waxler, Robinson, & Emde, 1992), whereas others have proposed unified (de Waal, 2008; Decety, 2010; Preston & de Waal, 2002), sequential (Barnett

& Mann, 2013; Davis, 1994; Davis, Hull, Young, & Warren, 1987; Gladstein, 1983; Marshall, Hudson, Jones, & Fernandez, 1995), and multi-dimensional (Batson, Fultz, & Schoenrade, 1987; Davis, 1983, 1994; Davis et al., 1987; Gladstein, 1983; Hoffman, 1984, 1987; Leiberg & Anders, 2006) views of one concept. Depending on the author perspective-taking belongs to either or both components, or as Batson et al. (1987, p. 19) sarcastically state: „Psychologists are noted for using terms loosely, but in our use of empathy we have outdone ourselves".

Alas, theory of mind research rivals research on empathy in this regard and recently the cognitive-affective distinction has been introduced to this field as well (see, e.g., Abu-Akel & Shamay-Tsoory, 2011; Kalbe et al., 2010; Shamay-Tsoory, 2011a; Shamay-Tsoory & Aharon-Peretz, 2007; Shamay-Tsoory et al., 2007; Shamay-Tsoory, Tibi-Elhanany, & Aharon-Peretz, 2006; for a similar distinction, see also Brothers & Ring, 1992). Cognitive theory of mind refers to the ability to solve second-order false-belief tasks, that is, the ability to identify and differentiate between knowledge of two people (Flavell, 1968; Wimmer & Perner, 1983). Affective theory of mind, on the other hand, is measured with tasks where the subject needs to identify an emotion within another person such as the faux-pas task (see, e.g., Baron-Cohen, O'Riordan, Jones, Stone, & Plaisted, 1999; Stone, Baron-Cohen, & Knight, 1998). Cognitive and affective perspective-taking belong to the respective theory of mind parts in this framework.

Problems arise when one takes an interdisciplinary look at perspective-taking: for instance, theory of mind researchers equate affective theory of mind with cognitive empathy. Cognitive theory of mind and affective empathy are described as independent stand-alone concepts (Shamay-Tsoory, 2011a). However, both cognitive empathy and cognitive theory of mind describe (within their respective frameworks) attempts to understand what another person is thinking. Such confusions are the result of an unhealthy focus on measurement content instead of underlying processes as a guideline to scientific theorizing. Almost ironically, similar processes are discussed within all theory of mind and empathy frameworks (see, e.g., Batson, 2009; Decety & Jackson, 2004; Keysers & Gazzola, 2007; Lamm, Batson, & Decety, 2007;

Mahy, Moses, & Pfeifer, 2014; Schaafsma, Pfaff, Spunt, & Adolphs, 2015; Uddin, Iacoboni, Lange, & Keenan, 2007) and on a process level, cognitive empathy and theory of mind resemble each other. In the following, such a process-based taxonomy of perspective-taking will be elaborated within the empathy literature and applied to theory of mind and social psychological perspective-taking research in order to non-arbitrarily organize different kinds of perspective-taking across all literatures.

Perspective-taking in empathy research. As Batson (2009, p. 3) put it, empathy is primarily invoked to answer two questions: first, how do people come to understand what another person is thinking and feeling? This closely resembles the basic definition of perspective-taking as a process and its most proximate outcomes (i.e., correctly or incorrectly entertaining another point of view). Second, why do people respond to the suffering of others with appropriate emotions and appropriate behavior? This only relates to consequences of perspective-taking and not to the process by which these come about. These central questions differ concerning temporal and procedural characteristics. Two taxonomies of empathic phenomena will be borrowed from prior research to tease those features apart.

Temporal aspects of empathy. Much of the confusion surrounding the concept of empathy stems from the question whether empathy is a process or the outcome of a process or both. Although many empathy researchers acknowledged this problem, rarely has it been incorporated into empathy theories. A precise model about empathic processes and outcomes was formulated by Davis (1994, p. 12ff.) which identifies four elements of a sequential empathy construct: antecedents, processes, intrapersonal, and interpersonal outcomes. This makes it easier to locate perspective-taking within the larger construct of empathy.

Antecedents. Antecedents refer to personality differences of the empathizer. Although there are important inter-individual differences in the propensity to engage in perspective-taking (Davis, 1983; Eisenberg & Lennon, 1983; Lennon & Eisenberg, 1987), these are of minor importance for the actual process and hence in the present context, too.

Processes. Most relevant for perspective-taking is the process level. People engage in perspective-taking (and other processes) to produce intrapersonal (e.g., assuming a different point of view) and interpersonal empathic outcomes (e.g., helping behavior).

Intrapersonal outcomes. In addition to being an empathic process, of course, intrapersonal outcomes are relevant for defining perspective-taking. Perspective-taking efforts usually stop either when the perspective-taker feels that a different point of view was assumed successfully or when the attempt was futile. At this proximal outcome level affective and cognitive intrapersonal outcomes can be differentiated. The underlying process of perspective-taking, however, should be the same for different contents. The likelihood that one engages in processes other than perspective-taking, however, could crucially depend on content.

Interpersonal outcomes. The interpersonal outcomes of perspective-taking are more distal and moderated by many additional features which are independent of the perspective-taking process itself. Therefore these outcomes are also of less relevance in the present context.

Procedural aspects of empathy. As mentioned above, perspective-taking is primarily an empathic process which involves very proximal intrapersonal outcomes, too. Having said that, it is important to distinguish it from other empathic processes that also lead to empathic outcomes. Davis (1994) distinguished *non-cognitive* (e.g., imitation processes), *simple cognitive* (e.g., heuristic inferences), and *advanced cognitive processes* (e.g., perspective-taking). A more recent and more exhaustive classification can be derived from Batson (2009) who identified eight processes frequently labeled as empathic. Going beyond Batson’s work the labels *experiential*, *noetic*, and *simulative* are proposed for the three classes of empathy processes. Although these processes are elaborated in the context of empathy, they are general processes that apply to theory of mind and psychological perspective-taking frameworks, too.

Experiential processes. Experiential empathy processes are automatically occurring processes which inadvertently produce empathic outcomes. The key difference between these and higher-order empathic processes such as perspective-taking is that they exert their influence independently of an active, willful attempt to take the perspective of someone else. The first group of experiential processes involves emotion contagion and related effects (concepts 3, 7, and 8 in Batson, 2009). Emotional contagion refers to immediate affective responses to the situation of another person (Hatfield & Cacioppo, 1994). Batson (2009) distinguishes feeling distress *just as* (concept 3), *because of* (concept 7), and *for* (concept 8) another person, but this distinction is unimportant in the present context because these responses do not describe perspective-taking processes.

The second group of experiential empathy processes are imitation processes (concept 2 and partially concept 3 in Batson, 2009), which have been recognized as a source of empathic outcomes from the beginning (Lipps, 1903). For instance, imitating someone's facial expression (so-called motor mimicry, cf. Dimberg, Thunberg, & Elmehed, 2000) has been referred to as *facial empathy* (Gordon, 1995). This was later generalized to non-facial posture matching and behavioral imitation processes under the label *motor empathy* (see, e.g., Blair, 2005; Decety & Jackson, 2004; Preston & de Waal, 2002). This kind of empathy is intricately linked to the mirror neuron system (Carr, Iacoboni, Dubeau, Mazziotta, & Lenzi, 2003; Rizzolatti & Craighero, 2004; Rizzolatti, Fogassi, & Gallese, 2001). Although the automaticity of these processes has been questioned repeatedly (see, e.g., Bavelas, Black, Lemery, & Mullett, 1986, 1987; Meltzoff & Moore, 1997), it is undisputable that also these experiential processes differ in their complexity from the other two classes of empathic processes and it is clear that perspective-taking is not an experiential process, because these do not overcome the egocentrism of a person. For instance, when we see a close friend crying in distress and we compassionately cry, too, the reasons for crying differ between our friend and us. Whereas our friend cries because of some event, we cry because of our friend and without appreciation of the reason for his or her distress. In other words, there is a purely egocentric motivation to cry.

Noetic processes. Noetic empathy processes correspond to the first and fifth concept in Batson (2009). Explicitly knowing another person's internal state (concept 1) is a special case of the more general imagination of what another is thinking or feeling (concept 5). These processes are more complex than their experiential counterparts are because they involve the active contemplation of another person. With regard to content-based definitions of perspective-taking they include both cognitive and affective contents. Traditionally, noetic processes have been described as a special form of perspective-taking, the *imagine-him* (Stotland, 1969) or *imagine-other perspective* (e.g., Batson, Early, et al., 1997; Davis et al., 2004). However, it is questionable to which degree noetic processes overcome the egocentrism of the empathizer.

In what is probably the most common perspective-taking paradigm participants read or listen to the story of a person in need, for instance, a college student whose parents died and who now has to care for younger siblings (see, e.g., Batson et al., 1989; Batson et al., 1991; Batson et al., 1988; Batson, Early, et al., 1997; Davis et al., 1996, 2004). In the imagine-other perspective participants are asked to imagine and focus on how the other person is thinking or feeling. In the imagine-self perspective (see also below), on the other hand, participants are asked to imagine how they themselves would feel in this situation. On the surface it seems that, if anything, the imagine-other perspective is less egocentric than the imagine-self perspective. There are, however, reasons to assume the opposite, too.

For example, the emotional consequences of imagine-other perspective-taking are more egocentric than those of imagine-self perspective-taking. Usually researchers assess empathy and personal distress of their participants after they listened to or read a story. Whereas empathy encompasses emotions such as compassion and tenderness, personal distress measures arousal and other negative emotional reactions. Whereas both instructions lead to higher ratings of empathy, only the imagine-self condition increases personal distress compared to a control condition (see, e.g., Batson, Early, et al., 1997; Lamm et al., 2007; Stotland, 1969). Imagine-other instructions, on the other hand, lead to stronger motivation for altruistic helping than imagine-self instructions (Batson et al., 1991; Batson et al., 1987). Feeling empathy and being motivated to help another indicates that one understands his or her plight and that one actively wants to help that person. Logically, however, whenever we aim to help someone else we are aware of being ourselves; we remain in our egocentric outlook onto the world. Feeling distress, on the other hand, indicates that we incorporated another person's plight into our subjective experience which obviously comes closer to the idea of overcoming our egocentrism. This interpretation is also consistent with the patterns of brain activation during the two kinds of perspective-taking (Ames, Jenkins, Banaji, & Mitchell, 2008; Lamm et al., 2007).

Furthermore, while it is clear that people come to identify with the target of perspective-taking following the imagine-self instruction (often indicated by "self-other merging", cf. Aron, Aron, & Smollan, 1992), the role of identification with the target after imagine-other instructions is still a subject of debate (Batson, 1997; Batson, Sager, et al., 1997; Cialdini, Brown, Lewis, Luce, & Neuberg, 1997; Davis et al., 1996, 2004; Maner et al., 2002; Neuberg et al., 1997). To give a more concrete example of this, imagine-other perspective-taking does not reduce prejudices (Vorauer & Sasaki, 2014), whereas imagine-self perspective-taking does (Galinsky et al., 2005; Galinsky & Moskowitz, 2000; Todd, Bodenhausen, Richeson, & Galinsky, 2011; for a critical review of the effectiveness of perspective-taking to reduce prejudices, see Lai, Hoffman, & Nosek, 2013; Lai et al., 2014). Vorauer and Sasaki (2014), who recently and systematically compared the two instructional sets, argue that the absence of prejudice-reduction in the imagine-other condition is due to heightened perceived potential for evaluation. Although Vorauer and Sasaki (2014) do not discuss this, it is additionally possible to think about the results of the imagine-self condition in terms of the contact hypothesis (Allport, 1954). Participants "took the place" of an outgroup member only in the imagine-self condition. This could have prompted the negative experiences associated with being a minority group member which consequently reduced prejudices against that group – much alike a classic study in which using a wheelchair on campus for one hour improved participants' attitudes towards the disabled even multiple weeks in the future (Clore & Jeffery, 1972).

Finally, although some research suggests that imagine-other perspective-taking leads to a larger number of other-related thoughts compared to the imagine-self condition (Davis et al., 2004), a closer inspection of these thoughts indicates that they are predominantly descriptive thoughts about the other person’s appearance. Furthermore the thoughts generated by the participants in the imagine-other condition in this experiment did not differ from a control group where participants were asked to watch a target passively without empathizing, which is obviously an egocentric act (Davis et al., 2004). This suggests that instead of overcoming one’s egocentrism, apparently one is merely taking a close look at another person through one’s own eyes following imagine-other instructions (see also Ames et al., 2008).

Simulative processes. The final class of empathy processes are simulative. These comprise the concepts 4 and 6 from Batson (2009), that is, the original concept of *Einfühlung* (Lipps, 1903) and what later has been called *role-taking* (Mead, 1934) or the *imagine-self perspective* (Batson, Early, et al., 1997; Davis et al., 2004; Stotland, 1969). These processes differ only historically: the term *Einfühlung* (concept 4) comes from aesthetics research. Researchers in this area were interested in how artists are able to immerse themselves in abstract or inanimate objects which they are trying to paint. Role-taking (concept 6), on the other hand, was first investigated by psychologists who were interested in much the same act – just in everyday people and with an animate target.

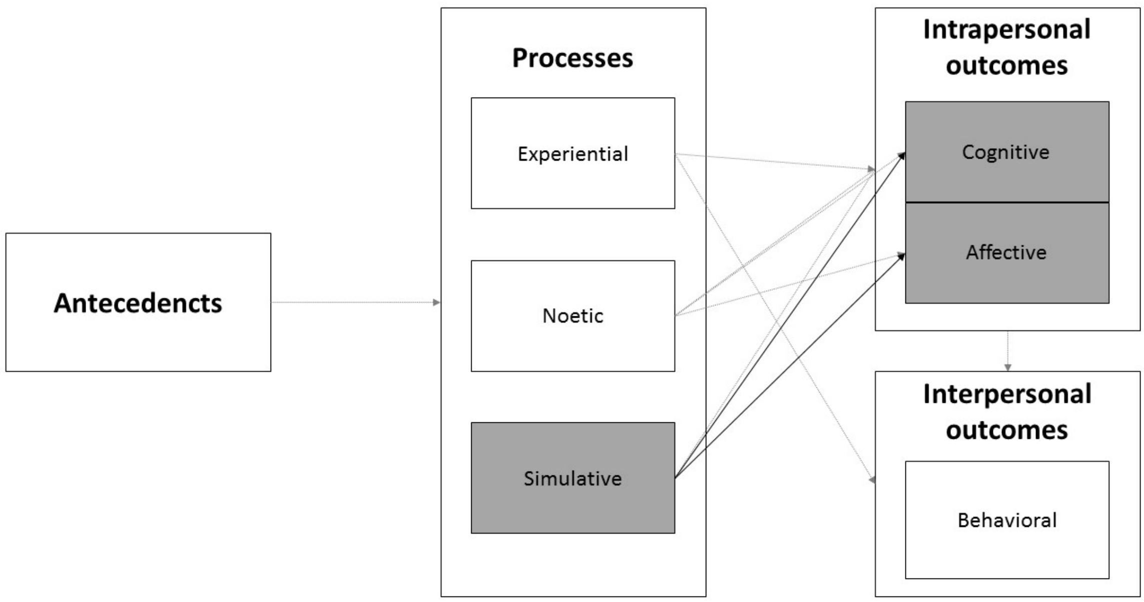
These processes are similar to noetic empathy processes in that a person willfully tries to understand another person’s thoughts or feelings, too, and again both affective and cognitive contents can be related to this type of processes. The major difference between these and noetic empathy processes is that whereas noetic judgments about the mental state of another person are based on theoretical and egocentric knowledge of the empathizer, simulative empathy processes correspond more closely to the idea of overcoming one’s egocentrism to entertain a foreign point of view (see, e.g., Davis, 1994; Ford, 1979; Kurdek, 1978; Mead, 1934; Piaget, 1932; Piaget & Inhelder, 1956; Underwood & Moore, 1982). The idea of simulative empathy is that the empathizer actually creates a second-hand experience of the situation of the empathy target rather than judging a situation based on personal knowledge. The fact that imagine-self perspective-taking creates arousal within the perspective-taker (Batson, Early, et al., 1997; Lamm et al., 2007; Stotland, 1969) indicates that compared to the “cold” and theoretical reasoning involved in noetic empathy processes, simulative processes involve actual experiences. This idea resonates well with the recently resurging framework of embodied or grounded cognition (Barsalou, 1999; T. W. Schubert & Semin, 2009), which puts a premium on simulation as one central feature of human cognition (Körner, Topolinski, & Strack, 2015; Myachykov, Scheepers, Fischer, & Kessler, 2014). The idea behind this body of work more broadly is that concepts are not represented amodally, but alongside the motor and sensory components that coincide with them. This idea is not restricted to representations in memory but applies to social cognition, too (Meier, Schnall, Schwarz, & Bargh, 2012; Niedenthal, Barsalou, Ric, & Krauth-Gruber, 2005; Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005; Niedenthal, Mondillon, Effron, & Barsalou, 2009).

Bodily simulations exert a strong influence on cognitive processing even in cases where this would not be expected. For instance, chewing gum can influence our evaluation of fantasy words (Topolinski, 2012; Topolinski, Lindner, & Freudenberg, 2013; Topolinski & Strack, 2009, 2010). This is because whenever we read a word, we articulate it subvocally – the pronunciation of the word is simulated by the oral motor system. When this happens repeatedly routines are practiced and the simulation becomes less effortful. This decrease in processing effort is hedonically pleasant for the perceiver. When the relevant muscles are kept busy by continuous chewing movements, however, these simulations are interrupted and no positive affect is created. Similar findings have been observed in the visual modality (Topolinski, 2010), and also for manual motor movements (Leder, Bär, & Topolinski, 2012; Topolinski, 2011).

In the context of empathy, recent research has addressed the modal grounding of mimicry, which presently would be labeled an experiential empathy process (Sparenberg, Topolinski, Springer, & Prinz, 2012). In a series of experiments these authors showed that merely performing a movement with the same effector as another social agent can lead to more positive attitudes towards this agent, which demonstrates strong involvement of sensorimotor processes in (experiential) empathy. Given the existing evidence for experiential consequences of simulative empathy processes, there likely is a sensorimotor contribution to this class of processes, too. But it is yet unclear which sensory or motor simulations happen when we engage in simulative perspective-taking (but for a recent proposal, see Erle & Topolinski, 2015).

Figure 1 summarizes the presently proposed framework of empathy as a whole with a focus on temporal (from left to right) and procedural (from top to bottom) aspects. Although all processes produce empathic outcomes, only simulative empathy processes constitute instances of perspective-taking within this presently proposed unitary view of the construct. Next, this taxonomy will be used to review theory of mind research as well as social psychological research on psychological perspective-taking.

Figure 1. The empathic sequence.



Note. Grey boxes and solid arrows indicate relevant areas for the perspective-taking process.

Perspective-taking in theory of mind research. The first authors to introduce the term *theory of mind* were Premack and Woodruff (1978) who defined it as the ability to attribute mental states to the self and conspecifics (chimpanzees in the case of their research) and to understand that foreign mental states can differ from own mental states. This again comes very close to the basic definitions of perspective-taking (see, e.g., Davis, 1994; Ford, 1979; Kurdek, 1978; Mead, 1934; Piaget, 1932; Piaget & Inhelder, 1956; Underwood & Moore, 1982).

In the previous section it was established that perspective-taking is a process which leads to a proximal outcome and exists among other empathic processes. Researchers from both fields agree that empathy and theory of mind are strongly related concepts, however, they are not completely overlapping. Whereas empathy is a complex social phenomenon involving also situational and behavioral components, theory of mind is a purely mental phenomenon without referents in the physical world. Therefore theory of mind depicts one part of the empathy sequence, namely some processes and their immediate outcomes (see Figure 1). This narrow definition has the advantage that unlike in empathy research there is a large consensus about the basic function of theory of mind and its temporal characteristics. However, there exists a longstanding debate between so-called theory and simulation theorists about the procedural characteristics of it. The distinction of experiential, simulative, and noetic processes is able to reconcile this and other theory of mind debates within one overarching framework.

Simulation and theory theories of theory of mind. As the term *theory* of mind emphasizes, originally mental state attributions were thought of as theoretical assumptions about another person's thoughts or feelings. Introspection allows humans only to access their own, but not other people's mental states directly. To compensate for this, theory theories of theory of mind assume that people form networks of rules and assumptions to predict what another person is thinking or feeling (see, e.g., Gopnik & Meltzoff, 1997; Wellman & Woolley, 1990). Importantly these predictions are necessarily guided by the knowledge structures of the theorizer and in fact independent of the actual experience of the target of the process.

Simulation theories of theory of mind, on the other hand, argue that people understand foreign mental states by simulating them for themselves (see, e.g., Decety & Grèzes, 2006; Gallese & Goldman, 1998; Goldman, 2006). Either this can happen automatically (although this is debated, cf. Apperly & Butterfill, 2009; Apperly, Riggs, Simpson, Chiavarino, & Samson, 2006; Apperly, Samson, & Humphreys, 2005; Butterfill & Apperly, 2013; Kovács, Téglás, & Endress, 2010; Phillips et al., 2015; Wellman, Cross, & Watson, 2001) or people actively attempt to create a second-hand experience of another person's situation. The crucial difference to theory theories is that the foreign mental state is actually experienced in the simulating person, too, whereas theory theorists assume that it is only theoretically recognized.

These two frameworks were originally seen as contradicting each other (Grèzes & Decety, 2001; Jeannerod, 2001). More recent research, however, acknowledges that they are not mutually exclusive and multiple pathways to the entertainment of foreign mental states have been identified since (Keysers & Gazzola, 2007; Mahy et al., 2014; Schaafsma et al., 2015; Schurz, Aichhorn, Martin, & Perner, 2013; Schurz et al., 2015; Schurz, Radua, Aichhorn, Richlan, & Perner, 2014; Uddin et al., 2007). How do these pathways map onto the presently proposed framework? Theoretic approaches to theory of mind correspond to noetic processes in the present framework. They are best described as a self-centered and other-focused attempt of understanding a foreign mental state which can have any content. They are self-centered in the sense that they are based on personal knowledge and other-focused in that they aim at predicting the state of another person. Simulation theories, on the other hand, correspond to simulative processes. They are best describes as other-centered and self-focused attempts of understanding a foreign mental state (again of any content). They are self-focused in the sense that the prediction of a mental state is based on personal experiences derived from a simulation and other-centered in the sense that the simulator puts him- or herself in another person's place.

The role of the experiential processes for theory of mind is debatable, because theory of mind was originally defined as an elaborate and intentional process (Gopnik & Meltzoff, 1997;

Perner, 1991; Premack & Woodruff, 1978; Wimmer & Perner, 1983). Some recent work, however, highlights developmental discontinuities in theory of mind performance and strongly hints at a the existence of a more primitive theory of mind mechanism, which young children exhibit long before they can engage in full-fledged perspective-taking (see, e.g., Apperly & Butterfill, 2009; Apperly et al., 2006; Apperly et al., 2005; Butterfill & Apperly, 2013; Kovács et al., 2010; Surtees, Butterfill, & Apperly, 2012). That is, very young children automatically match the mental state of another person by either imitative or compensatory behaviors while at the same time they are not able to identify mental states correctly. This implicit theory of mind mechanism resembles the previously described experiential processes.

Note that regardless of how many processes are included, this taxonomy is not content-based but purely based on processes. This implies two further important assumptions: first, and in line with recent theorizing, this framework assumes that noetic and simulative (and potentially experiential) theory of mind mechanisms coexist and can operate in parallel (cf., e.g., Keysers & Gazzola, 2007; Mahy et al., 2014; Schaafsma et al., 2015; Uddin et al., 2007). Second, all two (or three) classes of processes can operate on any content. This makes the presently proposed framework much more flexible than content-based distinctions of cognitive and affective theory of mind, which are discussed next (see, e.g., Abu-Akel & Shamay-Tsoory, 2011; Kalbe et al., 2010; Shamay-Tsoory et al., 2007; Shamay-Tsoory et al., 2006).

Cognitive and affective theory of mind. The distinction between cognitive and affective theory of mind largely rests on studies showing that lesions to specific brain areas specifically affect only some theory of mind measures. Based on these observations, affective theory of mind is said to centrally involve the ventromedial prefrontal cortex, whereas cognitive theory of mind is impaired only after more general and further distributed lesions in the prefrontal cortex (Shamay-Tsoory & Aharon-Peretz, 2007; Shamay-Tsoory et al., 2006). These findings were corroborated using transcranial magnetic stimulation as an experimental manipulation of “brain lesions” (Kalbe et al., 2010). However, these studies do not only point to differences between the two kinds of theory of mind, but also to large overlap, both anatomically (Abu-Akel & Shamay-Tsoory, 2011; Shamay-Tsoory, 2011a, 2011b) and in terms of task performance of “affective” and “cognitive” tasks (*r* = .764; Shamay-Tsoory & Aharon-Peretz, 2007). Therefore, differences between “affective” and “cognitive” theory of mind could also reflect peculiarities of the measures rather than the existence of two distinct constructs.

In agreement with this reasoning, more recent meta-analyses of the theory of mind literature therefore grouped different families of more or less similar theory of mind tasks rather than declaring the existence of different concepts (Bzdok et al., 2012; Mahy et al., 2014; Schilbach et al., 2012; Schurz et al., 2013; Schurz et al., 2015; Schurz et al., 2014). Still the question remains what makes these different tasks different. There are tasks using a verbal versus non-verbal presentation format (Carrington & Bailey, 2009), story versus non-story based tasks (Mar, 2011), and tasks involving a transient or non-transient mental state (Van Overwalle, 2009). “Cognitive” and “affective” tasks are evenly distributed across all of those categories, rendering a content-based taxonomy again suboptimal. But different theory of mind tasks differentially rely on experiential, simulative, or noetic processes.

The ventral/anterior temporo-parietal junction, a central area involved in simulative theory of mind processes, only responds to three task groups identified in a recent meta-analysis (Schurz et al., 2014). The first task group, *social animations*, shows geometric shapes moving across the display in a manner that portrays an intentional or social interaction and participants have to identify what is being depicted (Castelli, Happé, Frith, & Frith, 2000). In the second group, *rational actions*, cartoons depict an actor who intends to perform an action which participants again have to identify correctly (Brunet, Sarfati, Hardy-Baylé, & Decety, 2000). The last group of tasks which activate this area is the *minds-in-the-eyes-task* where participants see pairs of eyes and have to guess which emotion is displayed (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997). In contrast to the former two tasks these stimuli are static and also participants have to choose one emotion out of two or four options. Potentially because of these features, this task might recruit experiential rather than simulative processes, too. Indeed, it additionally strongly activates the inferior frontal gyrus (Schurz et al., 2014), an area classically associated with the mirror neuron system involved in experiential resonance and contagion processes (Keysers & Gazzola, 2007; Keysers, Kaas, & Gazzola, 2010; Rizzolatti & Craighero, 2004; Rizzolatti et al., 2001).

Finally, tasks involving covert mental states with no physical representation in the world (for the distinction between overt and covert mental states, cf. Gobbini, Koralek, Bryan, Montgomery, & Haxby, 2007; Perner & Roessler, 2010, 2012) that cannot be simulated, like classic *false-belief tasks* (Wimmer & Perner, 1983) and so-called *trait judgments*, where participants receive a verbal description of a person and a trait adjective and have to decide whether the story and the adjective match (Mitchell, Heatherton, & Macrae, 2002), require participants to reason based on their knowledge about the world to solve the task. This corresponds to the operating characteristics of noetic processes. Note that such noetic reasoning is (in principle) always possible for the other tasks, too, whereas simulation is never feasible for these tasks. It is thus not surprising that "noetic" areas are sometimes also involved in simulative tasks, although to a much lesser degree (cf. Schurz et al., 2014, p. 27).

To summarize, theory of mind can be described as one higher-order empathic process which serves the purpose of understanding foreign mental states. A purely content-based distinction seems unfeasible and consequently is being abandoned in recent analyses of the field (Bzdok et al., 2012; Mahy et al., 2014; Schilbach et al., 2012; Schurz et al., 2013; Schurz et al., 2015; Schurz et al., 2014). The processes underlying theory of mind correspond nicely to the proposed framework of noetic, simulative, and potentially (but to a lesser degree) experiential processes. Concerning their relation to perspective-taking the same conclusions that were already elaborated for empathy research can be drawn here, too, namely that only simulative processes correspond to the idea of full-fledged perspective-taking in the sense of adopting a non-egocentric frame of reference (see Figure 1).

Perspective-taking in social psychological research. The last research area in which psychological perspective-taking plays an important role is social psychology. The definitive starting point of this branch of research are studies on empathic perspective-taking and out of the instructional sets used there (see, e.g., Batson, Early, et al., 1997; Batson et al., 1987; Davis et al., 1996, 2004) at least the imagine-self instruction is widespread in social psychology, too (Finlay & Stephan, 2000; Galinsky & Ku, 2004; Galinsky & Moskowitz, 2000; Galinsky, Wang, & Ku, 2008; Todd et al., 2011; Todd, Galinsky, & Bodenhausen, 2012; Vescio, Sechrist, & Paolucci, 2003; Vorauer, Martens, & Sasaki, 2009; Vorauer & Sasaki, 2009, 2012, 2014). In addition, sometimes participants are asked to write a narrative essay about a typical day in the life of a target person (Galinsky & Ku, 2004; Galinsky & Moskowitz, 2000; Galinsky et al., 2008; Todd et al., 2011). This manipulation was adopted from research on thought suppression (Macrae, Bodenhausen, Milne, & Jetten, 1994) and is essentially another variation of the imagine-self perspective, that is, a manipulation instigating a simulative process.

In contrast to empathy and theory of mind research, social psychology never strongly debated the content of different tasks but rater saw them as referents of otherwise identical or similar processes. The main thrust of this research was not only to demonstrate that perspective-taking manipulations can affect social-cognitive processing but more importantly to investigate the mechanisms behind these effects. Social psychologists' conception of psychological perspective-taking is best summarized as "The ability to intuit another person's thoughts, feelings, and inner mental states" (Epley & Caruso, 2009, p. 297).

Concerning these mechanisms, Galinsky and Moskowitz (2000) showed that perspective-taking reduces stereotype expression by increasing self-other overlap. Later research identified moderators of this relationship, further emphasizing the central role of self-other merging. As an example, Galinsky and Ku (2004) found that this stereotype reduction was only present in subjects with a high self-esteem, because only for them the target of perspective-taking is associated with something positive (i.e., the positive self of the perspective-taker). In another study a negative relation between feelings of power and perspective-taking was demonstrated (Galinsky, Magee, Inesi, & Gruenfeld, 2006). This again makes sense in the light of self-other merging accounts because powerful people are by definition (see, e.g., Keltner, Gruenfeld, & Anderson, 2003; Keltner & Robinson, 1997) more autonomous than powerless people and thus independent of foreign perspectives. All of these reports proposed the idea that self-other merging happens because the self is projected into another person (cf. Davis et al., 1996; Van Boven & Loewenstein, 2003). However, this is only a theoretical claim and this was not directly tested in these studies.

Other studies also found evidence that self-other merging might be due to the inclusion of another person in the self (see, e.g., Galinsky et al., 2008). In these studies participants were instructed to imagine being a cheerleader (a group stereotypically perceived as physically attractive and unintelligent) or a professor (stereotypically considered intelligent). After these instructions they were asked to rate themselves on various attributes including these stereotypical associations. Participants rated themselves higher on both positive (attractive, intelligent) and negative (unintelligent) stereotype-consistent dimensions which is only in line with the idea that they included the stereotypes in their self-view and not with the idea that they projected their self-view onto these stereotypical people. Other researchers described the psychological perspective-taking process as egocentric anchoring and adjustment which again comes close to this idea (Epley & Caruso, 2009; Epley et al., 2004).

In the light of these contradicting findings the most comprehensive psychological perspective-taking framework incorporated both projection of the self onto the other as well as inclusion of the other in the self as possible consequences of perspective-taking which both create the feeling of self-other merging (Galinsky et al., 2005). This framework, however, leaves the question unanswered when which of these two processes is instigated. This is because social psychological research on perspective-taking primarily focused on processes that occur only once perspective-taking already happened and neglected the perspective-taking process itself. In a seminal chapter on the topic, for instance, this first part of the perspective-taking sequence is merely called “activating perspective-taking” with no further specification as to how this happens (Epley & Caruso, 2009). The merging of the self and the other which is declared as the central mechanism responsible for psychological perspective-taking effects is an outcome of perspective-taking processes rather than a causally responsible process. Perspective-taking instructions instigate a process leading to self-other merging which, once present, instigates further outcomes (e.g., prejudice reduction or empathy). Likely the decision between projection of the self and incorporation of the other is also made at this earlier stage.

Going back yet again to the presently proposed framework, the idea of self-projection into another person closely resembles noetic perspective-taking processes. These processes describe a self-centered and other-focused projection of personal knowledge which is used for rule-based theoretical reasoning about the state of another person. This projection does not fully overcome the egocentrism of the perspective-taker. The idea that own thoughts are projected into another person can be arranged with all commonly identified consequences of noetic processes, too. That is, feelings of empathy, motivation to help, and self-other merging, but no empathic experience (e.g., personal distress) within the perspective-taker. Problematically, some experiments employing the imagine-self instruction explain perspective-taking effects as a result of self-projection (Galinsky & Ku, 2004; Galinsky & Moskowitz, 2000). Based on the presently proposed framework this instruction should instigate simulative and not noetic processes. Upon closer inspection, however, it is unclear whether the results observed in the abovementioned studies truly reflect a direct projection of the self onto the other. Firstly, only one study actually assessed self-other overlap but did not distinguish empirically between self-projection and other-inclusion which both increase overlap (Galinsky & Moskowitz, 2000). In addition and more critically, self-other overlap was measured between the participant and whole outgroups (e.g., overlap between the self and “the elderly”). Thus, while it is possible that the (imagine-self) perspective-taking manipulation led to a simulation of being an elderly person, it is unclear how this could directly be translated into a group judgment because it seems impossible to imagine being a group. Therefore, potentially the causal sequence in these experiments was rather that first, a simulative process instigated an inclusion of the other in the self, and in a second step this experience is translated into a noetic judgment about the elderly as a group. Further research, preferably using the imagine-other instruction, should be conducted to clarify the role of noetic processes for the existing social psychological perspective-taking literature.

The inclusion of the other in the self, on the other hand, is intricately related to simulative processes and the idea of putting oneself in another person's place which creates a powerful second-hand experience of what it is like to be that person. This can change attitudes, feelings, the self-view, and many other important social-cognitive outcomes. The fact that most of the social psychological perspective-taking studies used the imagine-self or comparable instructions, combined with the incompatibility of their results with self-projection onto another, lend much credibility to the idea that these psychological perspective-taking effects indeed are simulative in nature and involve the inclusion of another person in the self. However, the aspects feeding into such psychological perspective simulations are largely unknown so far (but for a recent proposal, see Erle & Topolinski, 2015).

The role of experiential processes for psychological perspective-taking is again less clear which makes sense in light of the present framework, too, because these processes do not meet the definitional criteria of full-fledged perspective-taking. But there are more basic experiential processes like mimicry or imitation that are certainly related to perspective-taking but cannot be equated with it. These processes have been shown to automatically affect sympathy (Dimberg et al., 2000; Neumann & Strack, 2000), similarity judgments (Ashton-James, Van Baaren, Chartrand, Decety, & Karremans, 2007; Lakin & Chartrand, 2003), and even behavior (Chartrand & Bargh, 1999; Chartrand & Dalton, 2009). Although comparable outcomes can in principle stem from perspective-taking, too, these processes should be considered as another source of social-cognitive outcomes which is independent of psychological-perspective-taking (see Figure 1).

To summarize, the presently proposed framework can again be arranged with the findings of social psychological perspective-taking research. In addition to explaining the existing literature, the framework could be instrumental in answering open research questions such as when the different processes are engaged and which outcomes are likely associated with them. As already discussed for empathic perspective-taking, imagine-self instructions lead to self-other merging due to an inclusion of another person in the self-concept which is brought about by simulative processes. Imagine-other instructions, on the other hand, instigate noetic processes which cause self-other merging via a projection of the self onto another person, which gain does not fully overcome the egocentrism of the perspective-taker. Finally, and also as previously discussed, experiential processes are related to perspective-taking in the sense that they can cause similar outcomes but they do so by means of underlying processes that clearly do not overcome the egocentrism of a person.

Psychological perspective-taking processes revisited. This extensive literature review of three major areas of psychological research warrants a short interim summary. In the previous sections an effort was made to go beyond purely content-based segregated views of perspective-taking as affective or cognitive which even cannot be arranged with each other across different research fields. Rather a taxonomy of perspective-taking along the temporal and procedural dimension was elaborated.

Concerning the temporal characteristics, perspective-taking is a process which does not operate in a psychological vacuum. It has important antecedents and very distant social-cognitive and behavioral interpersonal outcomes. These, however, do not affect the procedural characteristics of the process per se. Rather they can influence, for instance, how often the process is utilized by different people and which behaviors are caused by this (Davis, 1983, 1994; Eisenberg & Strayer, 1987; Lennon & Eisenberg, 1987). Regarding whether unitary or segregated views of perspective-taking should be preferred, only the process level and proximal outcomes are relevant. At the process level it is unnecessary to separate, for instance, affective or cognitive referents of perspective-taking. Nonetheless it is possible that different perspective-taking (and related) processes affect these referents more or less frequently.

Concerning the procedural characteristics three classes of perspective-taking and related processes were identified across all three fields of research. The most basic processes were labeled experiential processes. These processes do not involve a willful contemplation of another person, but rather automatically operating mechanisms leading to imitation and resonance (Bavelas et al., 1986, 1987; Chartrand & Bargh, 1999; Chartrand & Dalton, 2009; Chartrand & Van Baaren, 2009) which do not overcome the egocentrism of a person.

Additionally there are two more elaborate processes that meaningfully can be segregated on a theoretical basis, namely noetic and simulative processes. Noetic processes describe a self-centered and other-focused theoretical approach to the thoughts and feelings of another person. The perspective-taker reasons about the state of another person based on personal knowledge. This creates an understanding of another mind independent of actual experience. Thus, noetic processes are egocentric in this sense. Existing labels for noetic processes are imagine-other empathic perspective-taking (Batson, Early, et al., 1997; Batson et al., 1987; Davis et al., 1996, 2004; Stotland, 1969), theory theories of theory of mind (Gopnik & Meltzoff, 1997; Wellman & Woolley, 1990), and projection of the self onto another person (Galinsky et al., 2005).

Simulative processes, on the other hand, are best described as an other-centered and self-focused simulation of a foreign mental state. Here the perspective-taker tries to create a second-hand experience of another person's state or situation. Although it is unclear which aspects exactly feed into this simulation of a foreign psychological perspective (but see Erle & Topolinski, 2015) this type of perspective-taking involves actual experience and the incorporation of foreign mental states into one's own self-construal, thoughts, and feelings. Existing labels for this category of processes are imagine-self perspective-taking (Batson, Early, et al., 1997; Batson et al., 1987; Davis et al., 1996, 2004; Stotland, 1969), simulation theories of theory of mind (Decety & Grèzes, 2006; Gallese & Goldman, 1998; Goldman, 2006), and incorporation of another person into the self (Galinsky et al., 2005).

Perceptual Perspective-taking

Having established a meaningful process-based taxonomy for psychological perspective-taking, in the following different aspects of spatial cognition are analyzed from such a perspective, too, in order to generate a similar taxonomy for perceptual perspective-taking. Although spatial abilities have been defined differently over the course of time, in contrast to psychological perspective-taking, research in this area has always been primarily concerned with the procedural differences rather than measurement content. For example, in one of the earliest accounts Thurstone (1938) defined *spatial visualization* as one of the seven primary mental abilities. He further segmented the concept into the three subcategories *Visualization*, *Spatial Relations*, and *Spatial Orientation*. Visualization comprises all mental transformations of objects (i.e., imagining rotations, movements, and changes in shape of an object). This facet of spatial visualization is a precursor of what is now referred to as mental rotation (Shepard & Metzler, 1971). Spatial relations means the ability to identify objects from different perspectives which closely resembles more recent definitions of visuo-spatial perspective-taking (see, e.g., Flavell et al., 1981; Piaget & Inhelder, 1956; for a recent review, see Zacks & Michelon, 2005). Finally, spatial orientation is the ability to integrate the self accurately into a given environment. In a later meta-analysis, Linn and Petersen (1985) break what they call *Spatial Ability* down into the subcategories of *Spatial Perception*, *Mental Rotation*, and *Spatial Visualization*. Although in their framework the categories are labeled differently, these authors overall discuss very similar spatial abilities.

Regardless of the framework adopted, the underlying processes of these spatial abilities are well defined which was necessary because they are also very similar. For instance, both object rotation and some forms of perspective-taking involve imagining multiple views of the same object, but the mechanisms by which the two processes operate are different (Huttenlocher & Presson, 1973, 1979; Koriat & Norman, 1984; Presson, 1982). The literature review of perceptual perspective-taking proceeds along the crucial differentiations between perspective and object transformation as well as level-1 and level-2 transformations (cf. Flavell et al., 1981; Masangkay et al., 1974) of visual impressions and spatial relations.

Perspective transformations vs. object transformations. As mentioned above, object rotation and some forms of perspective-taking are both concerned with imagining multiple views of the same object and both are *spatial transformations*, that is, object and perspective transformations, respectively (Michelon & Zacks, 2006; Zacks & Michelon, 2005). Concerning the nature of the transformation, object rotation is a mental rotation of an object on its spot (see, e.g., Huttenlocher & Presson, 1973, 1979; Koriat & Norman, 1984; Presson, 1982; Shepard & Metzler, 1971). In a classic object rotation task participants see two objects. The second is either a rotation of the first or a completely different object. Participants have to judge whether the two objects are the same and their reaction time is measured. Shepard and Metzler (1971) were the first to demonstrate that reaction times for correct answers increase as an almost perfectly linear function of angular disparity between the two objects. Perspective transformations describe the act of imagining what another person can see (level-1 perspective-taking) or how the world looks from another perspective (level-2 perspective-taking). The latter kind also involves a transformation process. But in contrast to the object-based rotation characterizing mental rotation, perspective-transformations involve a mental rotation of the self around a target object rather than a rotation of the object itself (see, e.g., Huttenlocher & Presson, 1973, 1979; Michelon & Zacks, 2006; Presson, 1982; Zacks & Michelon, 2005).

Although highly similar, one feature based on which these transformations can be teased apart is task difficulty, which is generally higher for perspective-taking (Huttenlocher & Presson, 1973). Similarly, young children can successfully solve object rotation tasks before perspective-taking tasks (Hardwick, McIntyre, & Pick Jr, 1976). However, this relative difference in difficulty is not absolute. It can be equalized by allowing participants to physically adopt the target position in perspective-taking tasks (Huttenlocher & Presson, 1979). Furthermore, while perspective-taking is harder when participants have to imagine the appearance of a whole object array from a different point of view, object rotation is more difficult when participants are asked for specific item positions within an object array after mental rotation (Huttenlocher & Presson, 1979; Presson, 1982). Finally, contrary to the linear increase of reaction times for object rotation, perspective-taking reaction times increase in a curvilinear fashion: the slope is quite flat until around 60-90° of angular disparity and only gets steeper afterwards (see, e.g., Janczyk, 2013; Kessler & Thomson, 2010; Michelon & Zacks, 2006; Roberts & Aman, 1993). Closely related to this crucial difference is the fact that perspective-taking and object rotation are differentially susceptible to the plane of rotation. Whereas it matters less for object rotation, perspective-taking performance is better when the rotation has to be performed in the ground-plane (see, e.g., Keehner, Guerin, Miller, Turk, & Hegarty, 2006; Wraga, Creem, & Proffitt, 1999).

These differences can be attributed to how the different transformations are achieved and which reference frames are involved in them. This is again because object transformations operate within the intrinsic reference frame of an object in relation to its environment. This corresponds to physically turning an object in our hands until it matches a reference object. Objects obviously can be turned in any rotational plane and not only the ground plane and therefore performance is not susceptible to different planes of rotation. Further speaking to this underlying mechanism, object transformations are influenced by concurrent hand movements (Wohlschläger, 2000, 2001; Wohlschläger & Wohlschläger, 1998) and manual and mental object rotation in general reveal similar response patterns (Gardony, Taylor, & Brunyé, 2014).

Perspective transformations, on the other hand, involve the rotation of the own egocentric reference frame into another spatial location (Kessler & Thomson, 2010;

Kozhevnikov & Hegarty, 2001; Kozhevnikov, Motes, Rasch, & Blajenkova, 2006; Michelon & Zacks, 2006; Surtees et al., 2013a, 2013b; Wraga et al., 1999; Zacks & Michelon, 2005; Zacks, Vettel, & Michelon, 2003). Obviously people can only move around an object in the ground plane which is why these transformations are easier in this plane of rotation. Supporting this mechanism, perspective transformations are modulated by concurrent movements of the whole body rather than the hands (Kessler & Rutherford, 2010; Kessler & Thomson, 2010; Kessler & Wang, 2012; Roberts & Aman, 1993) and giving participants the opportunity to physically move around the target of the perspective-taking process greatly facilitates the process (Huttenlocher & Presson, 1973, 1979).

Therefore, although object and perspective-transformations are very similar on the surface and performance between them is highly correlated (Hegarty & Waller, 2004; Hegarty & Waller, 2005; Kozhevnikov & Hegarty, 2001), only perspective-transformations involve changing the personal frame of reference. Thus, although highly similar, object rotation does not correspond to definitions of perspective-taking.

Different perspective transformations. On top of this distinction, it is also important to distinguish different perspective transformations because not all kinds of perceptual perspective-taking fit the general definition of overcoming one’s egocentrism to entertain a different point of view (see, e.g., Davis, 1994; Ford, 1979; Kurdek, 1978; Piaget, 1932; Piaget & Inhelder, 1956; Underwood & Moore, 1982). At a first glance this is surprising because all perspective problems superficially have the same internal structure and share the same basic elements. They always involve a perspective-taker (the original perspective or *self*-perspective), another person whose perspective is to be assumed (the target perspective or *other*-perspective), and finally an object onto which perspectives are taken. A visual perspective represents a relation between any two of these three elements, for example, the other’s representation of the object. Although the internal structure of different perspective problems is equal, they differ in at least two important aspects: perspective-taking can be further categorized based on the content of the transformation (i.e., visual vs. spatial) and the type of relation that is to be transformed (so-called “level-1” vs. “level-2” perspective problems).

Level-1 vs. level-2 perspective-taking. In general, two types of perspective judgments are distinguished (Flavell et al., 1981; for recent reviews, see Michelon & Zacks, 2006; Zacks & Michelon, 2005). The first and simpler kind, referred to as level-1-perspective-taking (Flavell et al., 1981; Masangkay et al., 1974), concerns whether an object is visible to someone or not. Humans are capable to perform such visibility judgments at around three years of age (Masangkay et al., 1974) and even primates are able to solve these problems to a certain degree (e.g., Hare et al., 2000; Tomasello et al., 2003). This process benefits from the asymmetry inherent to the front-back axis of the human body (cf. Kessler & Rutherford, 2010; Michelon & Zacks, 2006; Myachykov et al., 2014). To determine visibility, only the relation between a person’s front (which can be identified easily) and a target object must be represented correctly. Some visibility judgments furthermore involve occluding objects. Then, two spatial relations are relevant: the locations of a target and an occluding object in relation to a target person. Visibility depends on the relative position of these two objects in the front-view of a person. For instance, when the occluding and the target object are located in the same direction from the target person and the occluder is closer to that person, the object is invisible.

Recent research has shown that regardless of their complexity, level-1-perspective judgments are rendered by tracing the line of sight of the target person from the egocentric point of view of the self (Michelon & Zacks, 2006). Therefore, they crucially depend on the distance between the target person and the target object or the distance between the target object and the occluding object. The further these distances, the longer it takes to render a visibility judgment (see, e.g., Kessler & Rutherford, 2010; Michelon & Zacks, 2006; Surtees et al., 2013a, 2013b).

Since the differences between self and target perspective are unimportant for such judgments, level-1 perspective transformations also do not meet the central definitional criteria of perspective-taking such as de-centering to entertain a different point of view (see, e.g., Davis, 1994; Ford, 1979; Kurdek, 1978; Piaget, 1932; Piaget & Inhelder, 1956; Underwood & Moore, 1982). In accordance with this reasoning Kessler and Rutherford (2010) concluded that level-1 perspective-taking is “a form of motor resonance that does not rely on deliberate movement simulation” (p. 9). Going back to the perspective-taking processes elaborated in the context of psychological perspective-taking this is a quite explicit definition of level-1 perspective-taking as an experiential process. The fact that level-1 perspective-taking is solved largely by means of personal knowledge would also allow for the alternative interpretation that the underlying processes are noetic in nature. However, while level-1 perspective-taking certainly depends on personal knowledge, it operates rather automatically. But in cases where line of sight judgments are rendered with deliberation, the notion that a noetic process is going on is still tenable.

The second perspective transformation, level-2 perspective-taking, concerns how an object would look from a different vantage point (Flavell et al., 1981) and thus is more closely tied to the original definitions of perspective-taking. This kind of perspective-taking seems to be more difficult (Apperly & Butterfill, 2009; Surtees et al., 2012) and appears later during child development than level-1 perspective-taking; coinciding with the emergence of theory of mind abilities in children (Perner, 1991). Phylogenetically this ability also succeeds level-1 perspective-taking because primates are not able to solve level-2 perspective tasks successfully (see, e.g., Call & Tomasello, 2008; Hare et al., 2001; Tomasello et al., 2003) unless they physically move to assume the other’s perspective (Bräuer et al., 2005; Frith & Frith, 2007; Tomasello et al., 1998, 2005).

Level-2 perspective judgments involve a transformation of the egocentric frame of reference into an allocentric location (Kessler & Rutherford, 2010; Kessler & Thomson, 2010; Surtees et al., 2013a, 2013b). As shown by recent research this is achieved by an embodied transformation of the perspective-taker’s body schema into that of a target person. This embodiment of the process was demonstrated by showing that a rotation of the perspective-taker’s body away or towards the target increases or decreases the ease with which these transformations can happen (Kessler & Rutherford, 2010; Kessler & Thomson, 2010; Surtees et al., 2013a, 2013b). Instead of the front-back axis of the human body this kind of perspective-taking strongly involves the left-right axis, which also explains why a mental rotation of the self is needed for level-2 but not level-1 perspective-taking. Whereas it is easy to determine where the front and back of a person are facing, the symmetry between the left and right side of the human body makes it difficult to automatically identify a specific side without first taking the other's spatial frame of reference into account (cf. Myachykov et al., 2014). This also explains why the embodied simulation contains the *whole* body because embodiment of single parts would be insufficient to disambiguate its symmetry diagnostically.

Going back to the process-based framework of perspective-taking once again, it is clear that level-2 perspective-taking is a simulative process. In contrast to the simulative processes discussed for psychological perspective-taking, however, here the bodily input into the simulation is clearly identifiable: level-2 perspective-taking is a mental self-transformation during which the whole body schema is shifted into a new spatial location (i.e., a new frame of reference). There is also some evidence that level-2 perspective-taking can happen rather automatically (see, e.g., Böckler, Knoblich, & Sebanz, 2011; Böckler & Zwickel, 2013; Qureshi, Apperly, & Samson, 2010; Samson, Apperly, Braithwaite, Andrews, & Bodley Scott, 2010; B. Tversky & Hard, 2009) which would be in line with the idea that experiential processes can also be involved in level-2 perspective-taking. However, this seems to be the exception rather than the rule. Usually this happens in communication situations (Schober, 1993, 1995, 2005; Shelton et al., 2012) to smooth social interactions (for instance, when giving directions to a friend) without investing a lot of cognitive effort (but see Duran, Dale, & Kreuz, 2011). Furthermore, until now research has not addressed whether an actual simulative transformation of the body schema happens in such more automatic instances, too.

Finally, sometimes level-2 perspective problems are solved by non-embodied strategies (e.g., reasoning such as "her left corresponds to my right-hand side when she stands opposite of me”). This corresponds to noetic processes because they are based on a set of rules by the perspective-taker which are applied in a self-centered but other-focused manner. Interestingly, people who predominantly engage in such noetic strategies during level-2 perspective-taking also report lower levels of psychological perspective-taking (Kessler & Wang, 2012). Therefore, although in some cases noetic or experiential processes might be involved in solving level-2 perspective tasks, level-2 perspective-taking “is best conceptualized as the deliberate emulation or simulation of a body rotation, supporting the notion of endogenous sensorimotor embodiment“ (Kessler & Rutherford, 2010, p. 2), that is, as a simulative process.

These marked differences between the two kinds of perspective-taking are also reflected in the involved brain areas during level-1 vs. level-2 perspective-taking. The temporo-parietal Junction (TPJ) seems to be involved only in level-2 judgments (see, e.g., Keehner et al., 2006; Zacks & Michelon, 2005) and TPJ lesions coincide with deficits in level-2 perspective-taking (Samson, Apperly, Kathirgamanathan, & Humphreys, 2005). The TPJ is also an area heavily implicated in theory of mind tasks (Saxe, 2006; Saxe & Kanwisher, 2003; Saxe & Wexler, 2005) and empathy (Decety & Lamm, 2006, 2007, 2011). The TPJ is generally responsible for self-other distinction and the integration of external information with bodily experiences (cf., e.g., Abu-Akel & Shamay-Tsoory, 2011; Saxe & Kanwisher, 2003). Finally, it is also active during “out-of-body-experiences”, that is, when taking an allocentric perspective on the self (Arzy, Thut, Mohr, Michel, & Blanke, 2006; Blanke et al., 2005). In addition, posterior frontal areas involved in simulations of body movements are also active during level-2 perspective-taking (Schwabe, Lenggenhager, & Blanke, 2009). However, although this nicely complements the behavioral data on level-2 perspective-taking (Kessler & Rutherford, 2010; Kessler & Thomson, 2010; Surtees et al., 2013a, 2013b), one study did not find activation of these areas during level-2 perspective-taking (Wraga, Shephard, Church, Inati, & Kosslyn, 2005).

The neural mechanisms underlying level-1 perspective-taking, on the other hand, have received far less empirical attention. Since this kind of perspective-taking is independent from the body schema and movement simulations, it is most likely that visual areas responsible for object and person identification (cf. Goodale & Milner, 1992) are involved in this kind of perspective judgment. Unfortunately there is no conclusive evidence on this subject, yet.

Visual vs. spatial perspective-taking. One final distinction between spatial transformations is their content, that is, whether visual impressions or spatial relations are transformed. Although visual and spatial perspective-taking are closely related and share many characteristics they should not be equated (Surtees et al., 2013a, 2013b). Visual perspective-taking concerns how the world looks for another person, that is, if and how that person perceives a referential object. Therefore visual perspective-taking concerns a mental state, a subjective experience of a person. Spatial perspective-taking, on the other hand, concerns spatial relations between other people and their environment and necessitates no actual visual perception.

While most spatial relations have a direct visual, there are also some relations with no such correspondence. For instance the visual relation “the object is visible” cannot be meaningfully translated into a spatial relation. Level-1 perspective-taking therefore demarcates one of the rare instances where visual and spatial perspectives mismatch and also an instance where different processes are at work. When computing the visibility of an object, the above-mentioned line-of-sight tracing mechanism is employed. For level-2 perspective-taking, in contrast, recent evidence suggests that both kinds of level-2 perspective-taking involve the same embodied mental self-rotation, although there was a tendency for this process to be more pronounced for spatial perspective-taking (Surtees et al., 2013a, 2013b). The authors concluded that the processes underlying perspective-taking differ between types of perspective-transformations (level-1 vs. level-2), but generally not between different contents (visual vs. spatial) of perspective-transformations (Surtees et al., 2013a, 2013b).

Perceptual perspective-taking processes revisited. The previous sections sought to map the process-based taxonomy of experiential, noetic, and simulative processes elaborated in the context of psychological perspective-taking onto the perceptual realm, too.

A first crucial distinction was drawn between mental object rotation and perspective-taking. While both processes describe a spatial transformation involving simulation, only perspective-transformations concern differences between egocentric and allocentric frames of reference. Mental rotation, on the other hand, is based on an intrinsic object-centered frame of reference which excludes it from unitary definitions of perspective-taking.

A second crucial distinction was drawn between level-1 and level-2 perspective-transformations. Level-1 perspective-taking is best described as an automatically occurring line-of-sight tracing that happens completely egocentrically. The underlying processes of this kind of perspective-taking are predominantly experiential and in some cases can be noetic as well, again excluding this spatial ability from unitary definitions of perspective-taking. Level-2 perspective-taking, on the other hand, is the only spatial transformation which fully meets the definitional criteria of perspective-taking. This kind of perspective-taking is achieved by simulating a mental self-rotation of the perspective-taker’s body schema into the target’s position, that is, by means of a strongly embodied and simulative process. In some cases this simulation can be instigated rather automatically, too, which allows for the possibility that in some cases level-2 perspective-taking tasks are solved by means of experiential processes (Böckler et al., 2011; Böckler & Zwickel, 2013; Qureshi et al., 2010; Samson et al., 2010; Schober, 1993, 1995, 2005). Finally, in some cases participants solve level-2 perspective problems by means of noetic strategies. For instance, instead of engaging in an embodied self-rotation participants can adopt geometric transformation strategies (e.g., “if he sits opposite of me, his left is always my right side”). In cases where such noetic strategies are used to solve such perspective-taking tasks, participants remain completely egocentric and thus these instances also have to be excluded from unitary definitions of perspective-taking.

A final distinction between visual and spatial perspective-taking is only crucial for level-1 but not for level-2 perspective-taking where the underlying processes of visual and spatial perspective-taking are largely identical (cf. Surtees et al., 2013a, 2013b).

Putting it all Together: a Meaningful Taxonomy of Perspective-taking

Perspective-taking is a multidimensional social cognitive skill which serves the purpose of overcoming one's egocentrism to entertain a new point of view. The central question of the introduction was whether it should be considered a unitary or segregated construct, that is, which and if so how many kinds of perspective-taking can be summarized under this label. To properly answer this question, both the "what", that is, the outcomes of the process, as well as the "how", that is, the operating characteristics of the process per se, are of central importance. The introduction has shown that an exclusive focus on the "what" leads to terminological confusions and contradictory frameworks in areas that in principle investigate similar constructs. Can an additional focus on the "how" improve this situation?

In the introduction, three classes of processes were identified that appear in all relevant fields of research. These processes all can lead to outcomes commonly associated with perspective-taking, but they do so by different means. Taking into account the basic definition of perspective-taking as the attempt to adopt a different frame of reference, which of these processes can indeed be labeled as such?

First, while experiential processes clearly can produce outcomes similar to those of perspective-taking, their procedural characteristics are different. These processes are very eclectic, ranging from affective resonance and mirroring to line-of-sight computations. They only share the feature that they exert their influence on human social cognition automatically and that they usually produce a mental state egocentrically. For instance, while emotional contagion leads to the same emotion within two people, the reason for this state differs between the two. Similarly people can accurately judge the visibility of an object for another person but this happens independently from that person's visuo-spatial reference frame. This egocentrism disqualifies these processes from a unitary definition of perspective-taking.

Second, noetic processes describe a willful contemplation of a mental state within another person which is likely why they have been classically considered cases of perspective-taking. Upon closer inspection, however, it becomes obvious that these processes do not overcome the egocentrism of the processer at all. In fact, egocentrism is centrally involved in the outcomes of these processes. Across all fields of research, noetic processes operate by a rule-based computation of a likely mental state which is then projected from the self onto another person. The exact rule that is applied to the cognition at hand, however, differs between instances of noetic processes. This class comprises imagine-other empathic perspective-taking, theory-driven theory of mind processes, projection of the self onto another person, intentional computations of line of sight judgments, and rule-based solutions of level-2 perspective-taking tasks. In contrast to existing taxonomies, based on the present analysis noetic processes also should not labeled as “perspective-taking” according to the basic definition of the construct.

Third, simulative processes involve an active simulation of a mental state within another person which is then included into the own experience. These processes are truly allocentric and thus meet the definitional criteria of perspective-taking. Additionally, simulation is a general principle of human social cognition that can be applied to all relevant research areas which makes this class of processes also the most homogenous one. Whenever a simulative process is used to understand another person, full-blown perspective-taking happens – independent of the content or the mental state that a perspective-taker reasons about. Therefore, imagine-self perspective-taking, simulation theories of theory of mind, inclusion of the other in the self, and level-2 visuo-spatial perspective-taking are equivalent in terms of their modus operandi and thus should constitute the unitary construct of perspective-taking.

Embodied Self-rotation: THE Simulative Perspective-taking Process

What still remains partially unclear are the factors feeding into the simulation of a foreign psychological perspective. This is because studies on psychological perspective-taking usually use instruction manipulations. A lot of research has demonstrated that such instructions produce a feeling of self-other merging between the perspective-taker and the target. But what happens when a person is instructed to “put him/herself in another person’s place”? How does the perspective-taker achieve this state of oneness?

Research on perceptual perspective-taking offers one possible explanation of this because in contrast to “psychological perspective-taking” research, it thoroughly investigated the mechanisms underlying perspective-taking. Visuo-spatial perspective-taking is achieved by a mental self-rotation of the body schema into another person’s position. Based on the theory of grounded cognition, it is almost trivial to assume that this is also one source of conceptual self-other merging because this simulation describes the creation of a literal self-other overlap in terms of spatial relations. That this obvious connection has not been drawn so far is likely due to the segregation of different kinds of perspective-taking which led to independently developing fields of inquiry (i.e., psychological versus perceptual perspective-taking) with little interdisciplinary communication of research paradigms.

Following the presently elaborated unitary view of perspective-taking it is plausible to assume that the same simulative process underlies all kinds of perspective-taking. The main hypothesis of this thesis is that the embodied self-rotation which was identified as the central perspective-taking mechanism in perceptual perspective-taking research is also involved in psychological perspective-taking and hence visuo-spatial perspective-taking can lead to psychological outcomes, too. The literal, simulative, and embodied form of self-other merging during visuo-spatial perspective-taking is the modal grounding of the feeling of oneness central to psychological perspective-taking. In other words, whenever a person is instructed to “put him/herself in another person’s place” an imagination of what the world looks like for this person and an embodied self-rotation takes place. Therefore, psychological perspective-taking is grounded in perceptual perspective-taking or as David Hockney would put it: visuo-spatial perspective-taking plays an important role in settling and fixing the “how” of a social interaction, which then lets us determine the psychological “what”.

Hypotheses

Based on this theoretical framework, the following new hypotheses were proposed and tested across six experiments. In addition to these hypotheses, possible confounding factor are addressed in various studies.

1. The embodied self-rotation during level-2 visuo-spatial perspective-taking is the central simulation aspect of psychological perspective-taking. The spatial union created between two people modally grounds the psychological state of oneness between the perspective-taker and the target which causes further psychological outcomes. Thus, inducing visuo-spatial perspective-taking should also impact simulations of psychological perspectives and a purely perceptual induction of perspective-taking should lead to a greater incorporation of the thoughts and feelings of another person into one's own, too.

2. Embodied self-other merging during visuo-spatial perspective-taking tasks happens only at an angular disparity larger than 80° (see, e.g., Janczyk, 2013; Kessler & Rutherford, 2010; Kessler & Thomson, 2010; Roberts & Aman, 1993) and only when people do not engage in other non-simulative processes to solve the task. Whenever both of these conditions are met, the psychological consequences of visuo-spatial perspective-taking are homogenous and are not affected any further by other procedural variations (e.g., stimulus materials, task difficulty, and so on).

3. Based on a unitary view of perspective-taking, the conceptual self-other merging (cf. Aron et al., 1992) which is the central mediator of psychological perspective-taking effects is grounded in embodied self-transformations. Therefore, the psychological effects caused by these transformations (i.e., by visuo-spatial perspective-taking) must be related to such feelings of similarity, too,

Empirical Part

The empirical part is organized in four sections following the above-mentioned hypotheses. First, evidence is provided that visual perspective-taking can lead to the adoption of a foreign point of view in a psychological sense, too (Experiments 1 & 2). Three further Experiments (Experiments 2, 3 & 4) seek to rule confounding factors for these effects. Experiment 5 systematically addresses the embodiment of psychological perspective-taking effects. Finally, the relation between the demonstrated effects and self-other merging (Aron et al., 1992) which is a central feature of psychological perspective-taking effects (see, e.g., Batson, Sager, et al., 1997; Davis et al., 1996, 2004), is addressed (Experiment 6).

Power Analyses, Data Preparation, and Data Analysis

The sample sizes of the present studies were determined based on the effect size observed in Experiment 1 which was attached to a larger battery of studies for which the desired sample size was set to $N = 100$. Power analyses and effect sizes were calculated using g*Power (Faul, Erdfelder, Lang, & Buchner, 2007) and spreadsheets provided by Lakens (2013). Based on the effect size of the relevant interaction in Experiment 1 ($\eta_p^2 = .068$) sample sizes to achieve a power of $(1-\beta) = .95$ (conservatively assuming a correlation of $r = 0$ of repeated measures) were computed. They were $N = 92$ for two factorial mixed designs (Experiments 1 & 5), $N = 62$ for three factorial mixed designs with one between-subjects independent variable (Experiment 3), $N = 124$ for three factorial mixed designs with two between-subjects independent variables (Experiment 4), and $N = 61$ for complete within-subjects designs (Experiments 2 & 6). Thus, all studies had appropriate power.

These are the only exclusion criteria used in the present studies: trials with errors on the visual perspective-taking task were excluded from all analyses. Additionally trials with reaction times > 10000 ms were removed for reaction time analyses. Implausible and very extreme answers such as likely typos (e.g., “Leonardo da Vinci was born in 145” instead of “[…] in

1452”) were removed from the remaining analyses. For the analyses of the anchoring effect and the differences between participants’ and the target’s judgments, answers were *z*-standardized (cf., e.g., Strack & Mussweiler, 1997). Subjects with extreme responses to the trivia questions ($|z| > 3$) in any cell of the design were removed from the respective analyses. Finally, participants who always responded with the same button to the perceived similarity question in Experiment 6 were excluded from this analysis.

Experiment 1: Visual Perspective-taking Causes Psychological Perspective-taking

The first experiment was designed to test the main hypothesis that visuo-spatial perspective-taking leads to social-cognitive outcomes, too. To this end participants first completed a perceptual perspective-taking task (Kessler & Rutherford, 2010; Kessler & Thomson, 2010; Surtees et al., 2013a, 2013b). The angular disparity between participants and the target person in the picture was manipulated so that embodied self-rotation was necessary to solve the task only on half of the trials, whereas the other half of the trials could be solved egocentrically without transposing the body schema into the target’s position.

Following this visuo-spatial induction, the other person needed to be imbued with a mental state which should be the target of psychological perspective-taking. To this end a paradigm based on the anchoring heuristic (A. Tversky & Kahneman, 1974) was developed. A numerical anchor is an information that is provided before a judgment under uncertainty is made. Research has shown that numerical anchors draw participants’ judgments towards them. That is, the average answer to a trivia question is higher after a high numerical anchor was presented compared to when a low numerical anchor was presented. In the present studies participants answered a trivia question following the visuo-spatial induction on every trial. Before they came up with their own answer, the answer of the target person of the visuo-spatial task was presented. This person either always gave very high or very low answers to the trivia questions. These answers were high and low numerical anchors identified in prior research

(Mussweiler & Strack, 1999a, 1999b; Strack & Mussweiler, 1997) as the 15^{th} and 85^{th} percentile of all answers to a given trivia question.

Based on the idea that perceptual and psychological perspective-taking share a common simulation-based mechanism it was hypothesized that the mental state of the other person should be endorsed more strongly after embodied self-rotation compared to when no such rotation occurs. The physical merging of the self and the other leads to a psychological merging, too, which then leads to shared mental states. In other words, participants not only put themselves in the place of the target person perceptually and physically but also psychologically. Therefore a modulation of the anchoring effect after visuo-spatial perspective-taking was expected. Furthermore, this should be driven by the fact that participants' judgments are more similar to the answers of the target person after visuo-spatial perspective-taking.

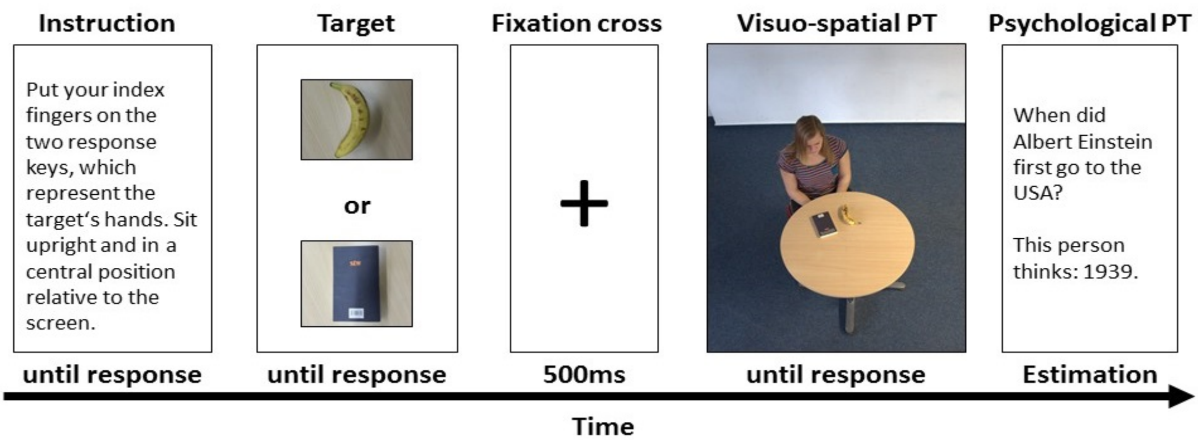
Methods. The study had a 2 (Anchor: high vs. low; between) X 2 (Angular Disparity: 40° vs. 160°; within) design. The visual perspective-taking paradigm was closely modeled after work on embodied transformation during visuo-spatial perspective-taking (Kessler & Thomson, 2010). The personalized anchoring paradigm was a modified version of classic works on the anchoring effect (Mussweiler & Strack, 1999a, 1999b; Strack & Mussweiler, 1997).

Visuo-spatial perspective-taking task. During the visuo-spatial perspective-taking paradigm, participants always see a person sitting at a table with two objects. One of the two objects is always the target object and participants have to indicate which hand the person would use to grab the target object from his or her position. Participants indicate their responses with the two response keys. From trial to trial the target object, the angular disparity between the avatar and the participant, and the participant's body orientation change orthogonally. In contrast to prior research where more levels of angular disparity were used, in Experiment 1 the target person always sat either at 40° or 160° of angular disparity.

On every trial participants first were instructed to sit upright and centrally in front of the screen and to put their index fingers on the two response keys. These were the Strg (Ctrl on a

German QWERTZ keyboard) keys on a normal computer keyboard which were additionally marked with a colored spot. This instruction was displayed until the participants pressed one of the two response keys. Then it was replaced by an image of the trial's target (i.e., either a book or a banana) and a letter string at the top of the screen translating to "Target object: which hand grabs the banana (book)?". Once the participant pressed one of the two response keys, the actual trial began. Participants saw a fixation cross at the center of the screen for 500 milliseconds which was then replaced by a picture of the target person at the table. As soon as participants pressed a response key to indicate which hand the person would use to grab the target object the anchoring part of the trial began (see below). The whole sequence of one trial is shown in Figure 2 and all instructions can be found in Appendix D.

Figure 2. Temporal sequence of events for one exemplary trial.



Note. PT = Perspective-taking.

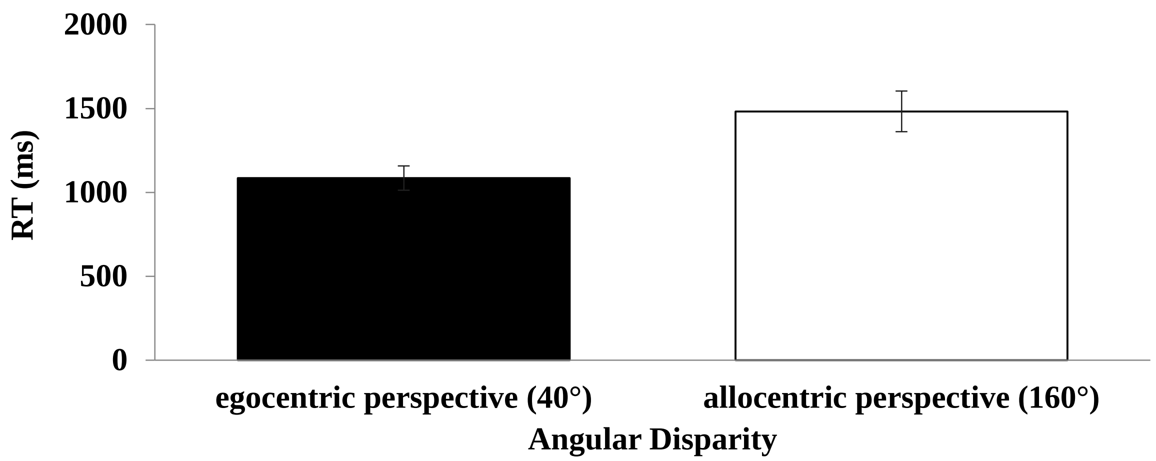
Anchoring paradigm. The only difference between the present anchoring paradigm and the original studies was that the numerical anchor was provided directly by the target person of the visual perspective task instead of a comparative statement. Specifically, after they solved the visuo-spatial perspective-taking task, participants were presented with a trivia question and the estimation of the perspective-taking target was displayed, too (see Figure 2). Experiment 1 used the same anchors as prior research with some minor changes (cf. Strack & Mussweiler, 1997; see Appendix A for the changes).

Sample. N = 102 people (n = 68 female; M_{age} = 27, SD = 9) participated for €10. The experiment was part of a longer battery including other unrelated tasks. It took participants about 5-10 minutes to complete this experiment.

Results. A 2 (Anchor: high vs. low; between) x 2 (Angular Disparity: 40° vs. 160°; within) mixed models ANOVA was computed for each dependent variable. These were, (1) the RTs of the visual perspective-taking task (as a manipulation check), (2) participants' mean estimations on the personalized anchoring task, and (3) the difference between participants' estimations and the numerical anchor.

Visuo-spatial perspective-taking. As in Kessler and Thomson (2010), RTs should be higher for the 160° trials than for the 40° trials, because only there a mental self-rotation happens before the left-right judgment is made whereas at 40° of angular disparity this judgment can be made right away. This hypothesis was confirmed by the ANOVA, which yielded only a significant main effect of Angular Disparity, $F(1,98) = 22.04$, $p < .001$, $\eta_p^2 = .18$ (all other effects, $F < 3.45$, $p \geq .067$, $\eta_p^2 = .03$). Figure 3 shows this main effect.

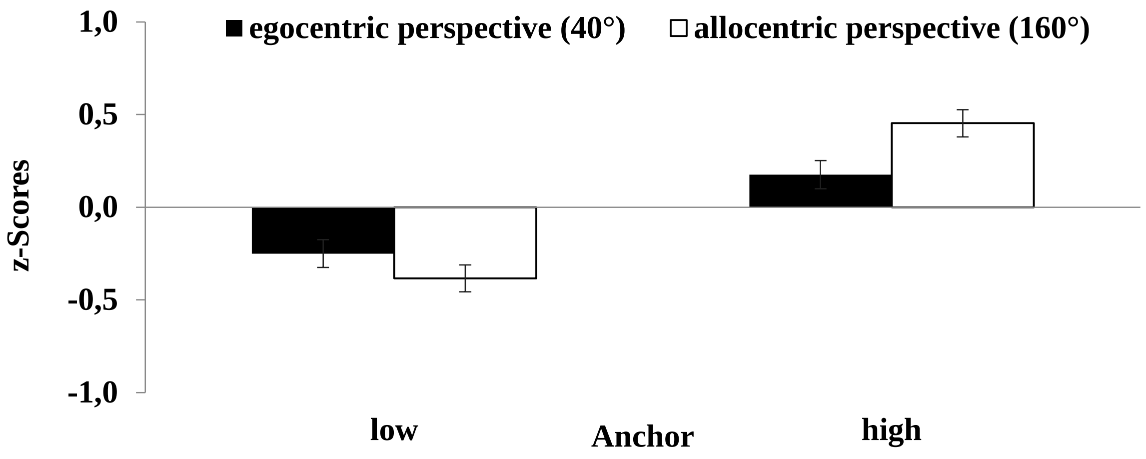
Figure 3. Reaction times of the visual perspective-taking task.



Note. Error bars represent +/- 1 Standard Error of Means (*SEM*).

Anchoring effect. An increased anchoring effect after visual perspective-taking was expected because the mental self-rotation creates a merging of the self and the other, which also leads to a shared psychological perspective (see Hypothesis 1). As expected, there was a significant anchoring effect, $F(1,97) = 77.27$, $p < .001$, $\eta_p^2 = .44$, which was qualified by a significant two-way interaction, $F(1,97) = 7.11$, $p = .009$, $\eta_p^2 = .07$. The anchoring effect was larger for the 160° trials ($d = 1.61$) than for the 40° trials ($d = 0.76$). For high numerical anchors, participants' responses were significantly higher for 160° trials than for 40° trials, $t(48) = -2.14$, $p = .038$, $d_z = 0.31$. For low numerical anchors, responses on 160° trials were only nominally lower than during 40° trials, $t(49) = 1.59$, $p = .118$, $d_z = 0.22$, see Figure 4.

Figure 4. The anchoring effect as a function of visual perspective-taking.

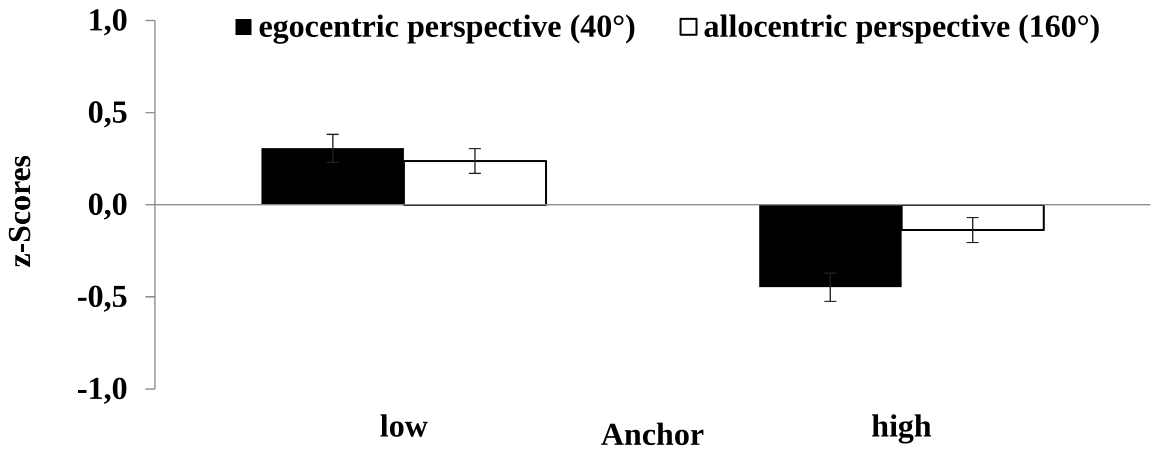


Note. Error bars represent +/- 1 *SEM*.

Anchoring differences. A smaller absolute difference between participants' judgments and the anchoring value after visual perspective-taking was expected. In addition to the stronger overall anchoring effect, this would indicate that participants incorporated the information provided by the target into their judgment instead of merely being biased (see Hypothesis 1). Corresponding to this hypothesis, the third analysis showed a significant main effect of Anchor, $F(1,97) = 67.57$, $p < .001$, $\eta_p^2 = .41$, which was qualified by a significant two-way interaction,

$F(1,97) = 6.34$, $p = .013$, $\eta_p^2 = .06$. Participants provided estimations closer to the judgmental anchor on 160° trials than on 40° trials. For high numerical anchors, deviations from the anchor were significantly smaller for 160° trials than for 40° trials, $t(48) = -2.50$, $p = .016$, $d_z = 0.36$. For low numerical anchors, responses on 160° trials were only nominally lower than during 40° trials, $t(49) = 0.80$, $p = .430$, $d_z = 0.11$. These results are plotted in Figure 5.

Figure 5. Standardized differences between participants' judgments and the provided anchor as a function of visual perspective-taking.



Note. Error bars represent +/- 1 *SEM*.

Discussion. Taken together these results suggest that visual perspective-taking can lead to psychological perspective-taking as indicated by a personalized anchoring paradigm. Participants were not only more biased by the numerical anchors after adopting an allocentric visual perspective, but also gave judgments that numerically were closer to the actual anchor provided by the target of the visual perspective-taking task. This was theoretically predicted as the consequence of an embodied self-other merging which caused participants to psychologically feel more similar to the target of the perspective-taking task, too.

Alternatively it is possible that visuo-spatial perspective-taking somehow interfered with the processes that precede the generation of a final judgment. For instance, the RT analysis of the perspective-taking task (see Figure 3) hints that the perspective-taking trials (160° angular disparity) are cognitively more taxing than the control trials (40° angular disparity). Under such circumstances people are likely to use heuristic cues as a source of information for their own judgments (see, e.g., Chaiken, Liberman, & Eagly, 1989; Petty & Cacioppo, 1986) and the statement provided by the other person could be used as such a cue. Alternatively, participants could also be cognitively attuned to "thinking hard" by the perspective-taking compared to the control trials which would likely lead to judgments based on more elaboration (see, e.g., Bless, 2001; N. Schwarz, 2002). Finally, it is possible that the added task difficulty impedes the ability to generate hypothesis-confirming information. Prior research has shown that the magnitude of anchoring effects depends on the amount of available target-specific information (Chapman & Johnson, 1999). Similarly, applying time-pressure to an anchoring task attenuates anchoring effects (Mussweiler & Strack, 1999b) because participants cannot generate the same amount of target-specific information in a shorter period of time (for a review, see Mussweiler, 2003).

However, it seems unlikely that the visual perspective-task affected the way in which participants generated their judgments. The RT of the judgment generation (which was unconstrained in this experiment) was also recorded. A 2 (Anchor: high vs. low; between) x 2 (Angular Disparity: 40° vs. 160°; within) ANOVA on these RTs yielded no significant effect (all *F*s < 0.82, all *p*s ≥ .369, all η_p^2s < .01). There was virtually no difference between the time participants took to come up with a response to the trivia question on 40° angular disparity (*M* = 11754 ms, *SD* = 4644 ms) and 160° angular disparity (*M* = 12100 ms, *SD* = 5000 ms) trials. Therefore, the style by which participants came up with their judgments did not differ between 40° and 160° of angular disparity which favors the theoretically generated interpretation over alternative judgmental bias explanations of the observed effects.

Furthermore, the predominant model used to explain anchoring effects is the selective accessibility model (Mussweiler & Strack, 1999a, 1999b; Strack & Mussweiler, 1997). This model assumes that a judgmental anchor sets a process of unidirectional hypothesis testing into motion. Participants generate a hypothesis about the true answer to the trivia question based on the provided numerical anchor. Subsequent information search is biased towards this hypothesis and hypothesis-inconsistent information is more readily discarded. It is also highly unlikely that visuo-spatial perspective-taking interfered with the accessibility of any kind of information compared to the control trials, because the standard anchoring paradigm differs from the presently used personalized anchoring paradigm in one important way. Whereas in the standard paradigm the anchor is provided by means of a comparative question that precedes the estimation by the participant (e.g., "Was Leonardo Da Vinci born *before or after* 1452?"), in the personalized anchoring paradigm the anchor is provided as an independent statement of the target person in the picture (e.g., "When was Leonardo Da Vinci born? This person thinks: 1452."). This deviation limits directional thinking to a high degree because participants do not have to place their own judgment on either side of the provided anchor before they come up with it. Furthermore, the manipulation of angular disparity was orthogonal of the provided numerical anchors. Therefore the person in the picture provided equal information during perspective-taking and control trials. Since control and perspective-taking trials did differ neither with regard to the provided information, nor with regard to the processing time of this information, selective accessibility unlikely accounts for the modulation of the anchoring effect.

In addition, the analysis of participants' differences to the provided anchors speaks against a selective accessibility explanation of the present results. Based on this account, the anchoring effect should be enhanced after perspective-taking because participants come up with additional, hypothesis-confirming information that goes beyond the provided anchors. In Experiment 1, however, the larger anchoring effect was driven by the fact that participants specifically endorsed the provided information more strongly after visuo-spatial perspective-taking (see Figure 5). Taken together, all this strongly favors a similarity based perspective-taking explanation over alternative explanations based on judgmental biases.

This first study also has some noteworthy limitations. For instance, the between-subjects operationalization of the numerical anchors allows for the possibility that the observed effects are due to characteristics of the two subsamples. Generally speaking, all effects were larger in the high anchor condition, although all results looked similar in the low anchor condition. Therefore it is possible that the results are due to a sampling error in the high anchor condition although this is unlikely because participants were randomly assigned to their respective conditions. Regarding the assessed demographic variables, there were non-significantly more women in the high anchor condition (79.17% vs. 62.50%; $X^2(1) = 3.23$, $p = .072$) and participants were non-significantly younger than in the low anchor condition ($M = 26$ vs. $M = 29$ years; $t(94) = 1.63$, $p = .107$). Therefore only an unknown third variable could account for the differences between conditions. To address potential third variables and to assess by which margin the anchoring effect was increased by visual perspective-taking, Experiment 1 was next replicated with a complete within-subjects design.

Experiment 2: Sample Characteristics and Effect Sizes

The second experiment was an almost exact replication of the first one. The only difference was, that instead of manipulating anchors between subjects, this study had a 2 (Anchor: high vs. low; within) x 2 (Angular Disparity: 40° vs. 160°; within) x 2 (Stimulus List; between) design. Two stimulus lists of four items were created and it was counterbalanced whether they were presented with high or low numerical anchors. Since there never was main or interaction effect of this independent variable, all *F*s < .74, all *p*s > .39 all η_p^2s < .01, the counterbalancing is not discussed from here on (i.e., all studies in which numerical anchors were manipulated within rather than between participants). By using a within-subjects design, the second experiment allowed for a comparison between egocentric and allocentric anchoring effect sizes and made it possible to ascertain whether the effects of Experiment 1 were due to specific characteristics of the samples.

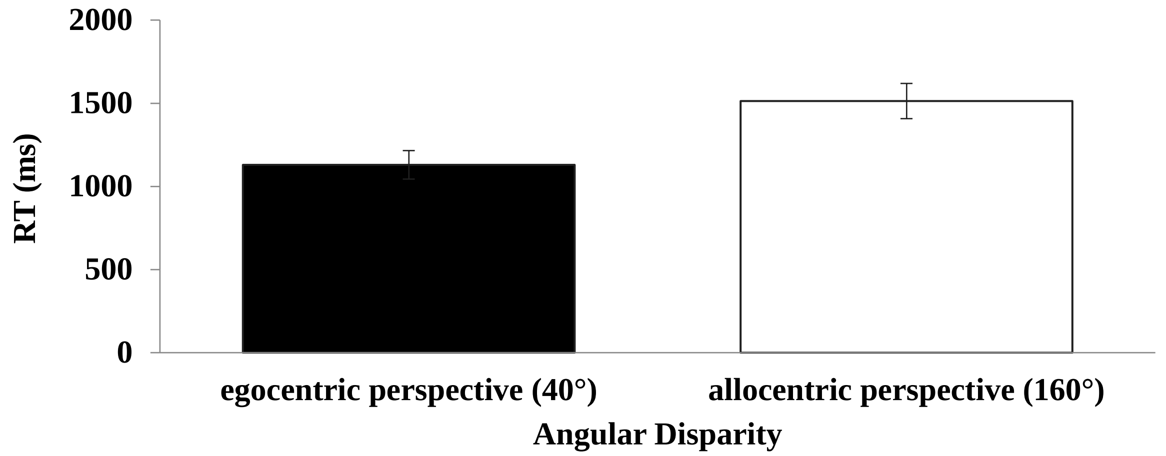
Methods. Participants completed eight trials with the same procedure as in Experiment 1 (instructions and stimuli can be found in the Appendix), that is four trials with 40° and 160° of angular disparity, respectively. In two of the 160° and the 40° trials the target person provided a high numerical anchor, whereas in the other two a low anchor was provided.

Sample. N = 97 people (n = 69 female; M_{age} = 27, SD = 10) participated. They were recruited at the university cafeteria and participated in a separate room in exchange for a candy bar. It took participants about 5-10 minutes to complete this experiment.

Results. The same analyses as in the first experiment were computed. Participants who committed errors on all trials of at least one cell of the design had to be excluded from the analyses by list-wise deletion. This led to the removal of n = 10 participants. Another n = 3 and n = 2 participants were excluded from the anchoring effect and the anchoring differences analysis, respectively, because of too extreme responses (see Data Analysis).

Visuo-spatial perspective-taking. The first analysis replicated Experiment 1: participants' responses became slower with increasing angular disparity as indicated by a significant main effect, $F(1,86) = 17.24$, $p < .001$, $\eta_p^2 = .17$, see Figure 6. All other effects were not statistically significant, all Fs < 2.96, all ps ≥ .079.

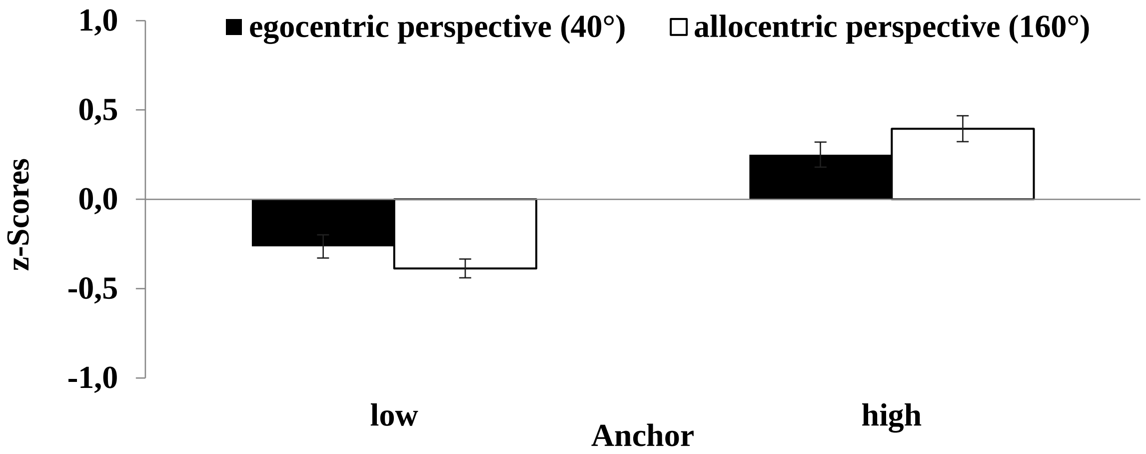
Figure 6. Reaction times of the visual perspective-taking task.



Note. Error bars represent +/- 1 *SEM*.

Anchoring effect. There was again a significant anchoring effect, $F(1,82) = 85.71$, $p < .001$, $\eta_p^2 = .51$, which was qualified by a significant two-way interaction, $F(1,82) = 5.02$, $p = .028$, $\eta_p^2 = .06$. The anchoring effect for the 160° trials was increased by $d_z = 0.25$ compared to the 40° trials. Participants' judgments were more extreme at 160° of angular disparity compared to 40° trials. Individually, this difference was neither significant for high numerical anchors, $t(83) = -1.55$, $p = .126$, $d_z = 0.17$, nor for low numerical anchors, $t(83) = 1.57$, $p = .120$, $d_z = 0.17$. These results are displayed in Figure 7.

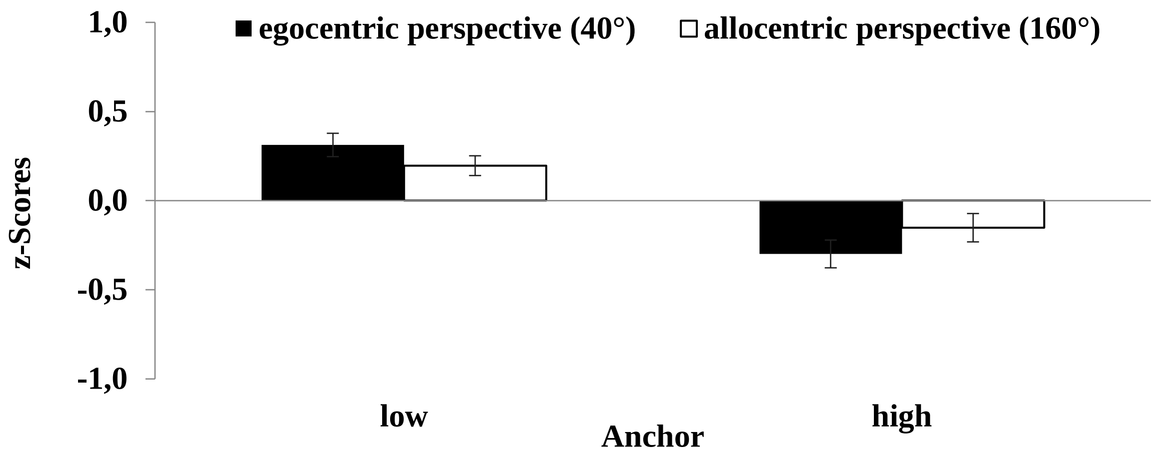
Figure 7. The anchoring effect as a function of visual perspective-taking.



Note. Error bars represent +/- 1 *SEM*.

Anchoring differences. The third analysis also replicated Experiment 1: there was again a significant main effect of Anchor, $F(1,83) = 40.64$, $p < .001$, $\eta_p^2 = .33$, which was qualified by a significant two-way interaction, $F(1,83) = 4.47$, $p = .037$, $\eta_p^2 = .05$. Participants provided estimations closer to the judgmental anchor on 160° trials than on 40° trials. Individually, deviations from the anchor were only nominally smaller for 160° trials than for 40° trials both for high numerical anchors, $t(84) = -1.39$, $p = .169$, $d_z = 0.15$, as well as low numerical anchors, $t(84) = 1.42$, $p = .161$, $d_z = 0.15$. These results are plotted in Figure 8.

Figure 8. Standardized differences between participants' judgments and the provided anchor as a function of visual perspective-taking.



Note. Error bars represent +/- 1 *SEM*.

Discussion. Overall, Experiment 2 replicated the results of Experiment 1 and showed that the anchoring effect was increased by an effect size of d_z = 0.25. Furthermore, this experiment conclusively rules out that the effects of the first experiment were due to sampling errors. Whereas the crucial Angular Disparity x Anchor interaction of Experiment 1 was mainly driven by the high anchoring condition, the contributions of the low and high anchor trials to this interaction were virtually identical and non-significant in Experiment 2, which is also in line with Hypothesis 1 of this thesis: the embodied self-other merging which happens at 160° should increase the influence of another person's thoughts regardless of their exact nature.

Concerning differences in the way participants came up with their own estimations, the RT for answering the trivia question was again subjected to a 2 (Angular Disparity: 40° vs. 160°) x 2 (Anchor: high vs. low) repeated measures ANOVA, which again yielded no significant effect (all *F*s < 0.72, all *p*s ≥ .401, all η_p^2s < .01). The manipulation of visuo-spatial perspective-taking seemingly did not affect the generally accepted mechanisms of the selective accessibility model of anchoring effects (Mussweiler & Strack, 1999a, 1999b; Strack & Mussweiler, 1997). Rather than changing the way how participants confirm or refute their hypothesis about the estimation at hand, it seems that visuo-spatial perspective-taking affected the specific hypothesis participants based their judgments on. Concerning this, both studies could show that participants adhered more closely to what the target person of the visuo-spatial task thought (see Figures 5 and 8). This is in line with the proposed mechanism of embodied self-other merging which leads to a psychological state of oneness and the adjustment of egocentric to allocentric mental states.

The crucial difference between the first two experiments was that the numerical anchors provided by the target of the visual perspective-taking task were manipulated either between or within participants. The obvious advantages of the within subjects manipulation notwithstanding, there were certain drawbacks to this procedure, too. First, the complete within-subjects design reduced the number of trials per cell of the design even further which made it necessary to exclude a good proportion of the sample (10.31 %) from the final analyses because they committed too many errors. Furthermore, although within-subjects designs generally increase power, the observed effects were smaller in Experiment 2. To explore the reason for this the repeated-measures correlation for the egocentric and allocentric anchoring effects was computed, which was virtually zero, $r(84) = .04$, $p = .722$. This explains why in this particular case a within-subjects manipulation actually decreases statistical power. In addition, it is conceivable that providing every participant with only either high or low numerical anchors increases the strength of the effect because consistently high or low numbers could have an synergetic effect on the subsequent trials of the task (cf., e.g., Furnham & Boo, 2011). Forestalling the results of the remaining studies, this finding proved to be rather consistent and the remaining experiments fluctuate between the two operationalizations. Although puzzling, this suggests that the present effects are rather robust against method-specific variations.

Having established the reliability of the observed effect in two independent experiments, the following two experiments (Experiments 3 & 4) sought to rule out potential confounding factors for the observed effects before the final two experiments move on to positively demonstrate the proposed mechanisms of embodied self-other merging (Experiment 5) and its relation to psychological self-other merging (Experiment 6).

Experiment 3: Stimulus Effects

The third experiment sought to rule out potential effects of the stimuli used in Experiment 1 and 2 on the observed results. Pictures where the target person is sitting at 40° versus 160° angular disparity differ with regard to the necessity to engage in visuo-spatial perspective-taking and hence with regard to whether they evoke embodied self-other merging by means of mental self-rotation (Kessler & Rutherford, 2010; Kessler & Thomson, 2010; Surtees et al., 2013a, 2013b). In addition to this theoretically important difference, the pictures also differ, for instance, concerning the perceived spatial distance between the person in the picture and the participant, the vertical position of the target on the screen, and the direction the target is facing (i.e., the target faces the participant only at 160° of angular disparity). Thus, there are several theoretical accounts which could explain the observed results alternatively.

Firstly, construal level theory describes psychological distance as intricately linked to physical distance (for a review, see Trope & Liberman, 2010). Based on this reasoning, a high perceived spatial distance also leads to psychological distance and most importantly to a more abstract level of construal. Prior research has shown that this enhances judgments compared to a construal level (see, e.g., Kanten, 2011) and also that higher levels of construal lead to more compromises in negotiations (Henderson & Trope, 2009; Henderson, Trope, & Carnevale, 2006). Assuming that participants viewed the trivia question as a negotiation with the target in the picture, this could be arranged with the results of the Experiment 1 and 2, especially with the reduced differences between the numerical anchor and participants' judgments.

Secondly, high verticality has been associated with many different psychological variables (for reviews, see Meier et al., 2012; T. W. Schubert & Semin, 2009), such as positive affect (Corneille & Yzerbyt, 2014; Crawford, Margolies, Drake, & Murphy, 2006; Meier &

Robinson, 2004), power (Lakens, Semin, & Foroni, 2011; L. Schubert, Schubert, & Topolinski, 2013; T. W. Schubert, 2005), morality (Lakens, 2012; Meier, Sellbom, & Wygant, 2007), and divinity (Meier, Hauser, Robinson, Friesen, & Schjeldahl, 2007). This offers several alternative explanations of the previous results: for instance, the person at 160° angular disparity might be perceived as more powerful and this made his opinion seem more important for the participants. Or the person might be evaluated more positively at 160° angular disparity and positive affect or sympathy are important pre-conditions for perspective-taking (Batson, Chang, Orr, & Rowland, 2002; Batson, Polycarpou, et al., 1997) or might serve as heuristic biases during the anchoring task (see, e.g., Bless, 2001; Chaiken et al., 1989; Petty & Cacioppo, 1986; N. Schwarz, 2002). Furthermore verticality corresponds to higher numerical quantities (see, e.g., Fischer, 2012; Ito & Hatta, 2004) because when quantities increase, objects literally pile up (Myachykov et al., 2014) – the so-called vertical SNARC (Spatial-Numerical Association of Response Codes) effect (Dehaene, Bossini, & Giraux, 1993) which can be universally observed across cultures (Shaki & Fischer, 2012) and modalities (Fischer, Riello, Giordano, & Rusconi, 2013; Rusconi, Kwan, Giordano, Umilta, & Butterworth, 2006; W. Schwarz & Keus, 2004). The 160° pictures might have primed higher quantities because the person is presented at the top of the screen, whereas the 40° pictures might have primed lower quantities. However, this cannot account for the results of the low anchoring condition where verticality should decrease the effect of low anchors. At the same time, note that the enhancement of the anchoring effect was strongest in the high anchoring condition of Experiment 1 so far.

Thirdly, many experiential processes such as mimicry can be spontaneously elicited by simply perceiving the facial expression of a conspecific and can lead to a positive rapport between two people. Although the models were instructed to look slightly down at the table and to have a neutral facial expression it is possible that there was a residual influence of their facial expressions on participants' judgments. Since the targets were facing the participants only at 160° of angular disparity, this is another alternative explanation of the previous results.

To summarize, many of the potential confounding factors offer (partial) post-hoc explanations of the previous data. Therefore the aim of the third study was to keep all stimulus features constant while removing the perspective-taking aspect from the setup. By means of this all of the abovementioned confounding variables could be ruled out in one single experiment. If any of those variables would account for the results of the first two experiments, it should do so in the absence of visuo-spatial perspective-taking, too.

Methods. To keep the stimuli constant while removing the perspective-taking aspect from the task, an *egocentric task* was introduced and compared with the perspective-taking task of the first experiments (now *allocentric task*). It was predicted that the anchoring effect should not be modulated for participants completing the egocentric task because the stimuli are not sufficient to instigate a simulation of a foreign psychological perspective. All stimulus materials in this study were the same with only one exception: the low anchoring value of the Einstein item (see Appendix A) was changed from 1921 to 1909 to correct a previously made error.

Allocentric perspective-taking task. The allocentric task was the same as in Experiments 1 and 2 (see Appendix D for the instructions). Participants completed eight trials of the visual perspective-taking task followed by the personalized anchoring paradigm. Angular disparity and the numerical anchors were manipulated within participants (see Experiment 2).

Egocentric perspective-taking task. The egocentric task had the same procedural details as the allocentric task of this study. The only difference was that during the instructions participants were told to grab the target object from their own egocentric visuo-spatial perspective rather than from the allocentric perspective of the person in the picture (see Appendix D). Therefore participants in the egocentric task condition saw the same pictures, answered the same trivia questions, and received the same numerical anchors as participants in the allocentric task condition, but they never had to engage in visuo-spatial perspective-taking.

Sample. $N = 96$ people ($n = 59$ female; $M_{age} = 21$, $SD = 3$) participated. They were recruited at the university cafeteria and participated in a separate room in sessions of up to ten participants. As compensation, they received a candy bar. It took participants about 5-10 minutes to complete this experiment.

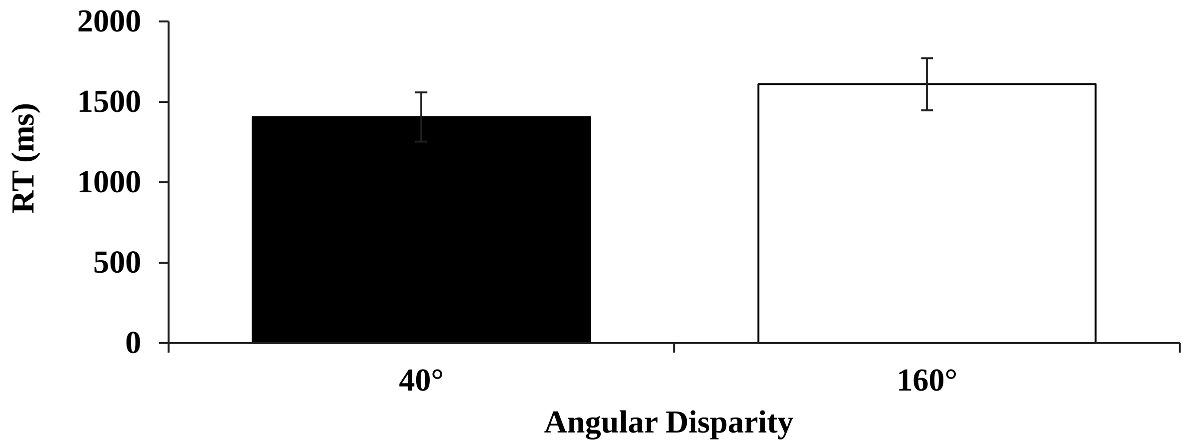
Results. Three 2 (Anchor: high vs. low; within) x 2 (Angular Disparity: 40° vs. 160°; within) x 2 (Task: allocentric vs. egocentric; between) mixed models ANOVAs with the same dependent variables as in the prior studies were computed. For the anchoring effect analysis, $n = 1$ participant was excluded for extreme responses.

Visuo-spatial perspective-taking. This analysis yielded no significant effects, all Fs < 2.70, all ps ≥ .107, likely because many participants from the egocentric condition ($n = 30$; 63.83%) had to be excluded from the analysis because they committed too many errors. For this analysis, two possible outcomes were anticipated which both cannot be arranged with this: originally, an interaction between Angular Disparity and Task was expected because 40° and 160° of angular disparity are equivalent in terms of task difficulty in the egocentric task condition but not in the allocentric task (see Experiments 1 and 2).

Alternatively, a main effect was possible if participants also found it more difficult to complete the 160° trials in the egocentric condition. As discussed in the introduction, some research suggests that level-2 perspective judgments can be instigated rather automatically (see, e.g., Böckler et al., 2011; Böckler & Zwickel, 2013; Qureshi et al., 2010; Samson et al., 2010; B. Tversky & Hard, 2009), especially when another social agent is present and an action of this agent is implied. People even spontaneously adopt the visual perspective of geometric forms when they perceive these to be agentic (Zwickel, 2009; interestingly, people in the autism spectrum do not, see Zwickel, White, Coniston, Senju, & Frith, 2011). When an agent is present and an action is implied, in one study participants were about five times as likely to spontaneously adopt an allocentric frame of reference to answer a perspective question although it was never mentioned that they should do this (B. Tversky & Hard, 2009). In another set of studies it was even shown that it is hard for people to avoid automatically adopting a different frame of reference even when it makes a task more difficult or when participants are actively instructed against doing so (Duran et al., 2011; Samson et al., 2010). Since the presently used task involves action ("which hand grabs the banana?") it is possible that also participants in the egocentric task would construct the spatial layout of the scene allocentrically at first.

Reaction times for the conditions would be similar in this scenario although the underlying processes would differ. Reaction times in the allocentric task should be increased at 160° of angular disparity because a mental rotation is more difficult than the simple matching strategy employed at 40° of angular disparity. In the egocentric task, reaction times should be increased at these angles because participants first need to inhibit the allocentric perspective before they can move on and locate the target object from their egocentric frame of reference. Nonetheless, this would result in a main effect of Angular Disparity. Although the pattern corresponded more to this hypothesis (see Figure 9), the depicted main effect of Angular Disparity was not significant, $F(1,53) = 2.69$, p = .107, $\eta_p^2 = .05$.

Figure 9. Reaction times of the visuo-spatial perspective-taking task.

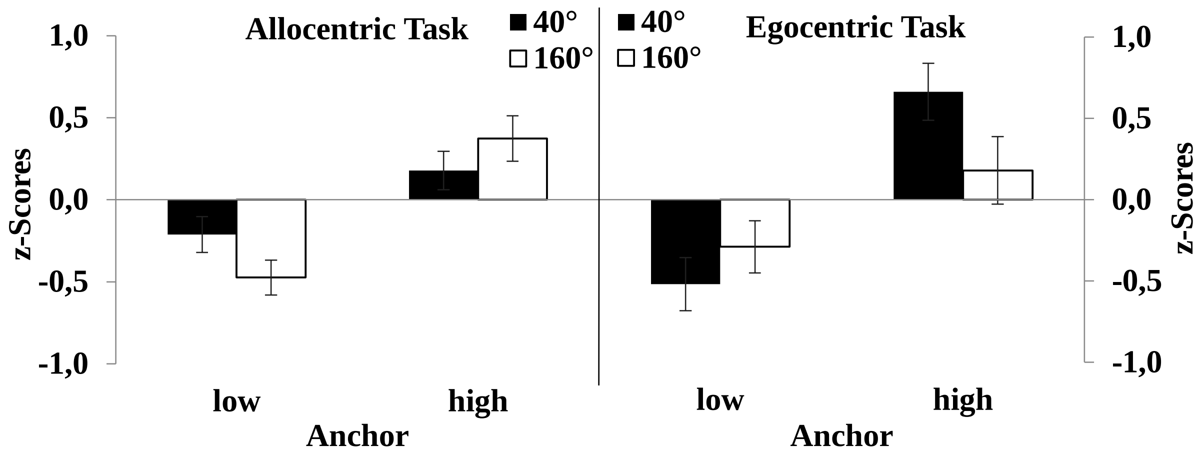


Note. Error bars represent +/- 1 *SEM*.

Anchoring effect. In spite of the failed manipulation check, there was again a significant anchoring effect, $F(1,50) = 43.07$, $p < .001$, $\eta_p^2 = .46$, which was qualified by a significant three-way interaction, $F(1,50) = 7.63$, $p = .008$, $\eta_p^2 = .13$. To specify it, separate two-way

ANOVAs were computed for the egocentric and the allocentric task. In the allocentric task, there was a significant main effect of Anchor, $F(1,35) = 22.07$, $p < .001$, $\eta_p^2 = .39$, but no significant two-way interaction, $F(1,35) = 3.96$, $p = .055$, $\eta_p^2 = .10$. However, the pattern of results largely resembled that of the prior experiments: the anchoring effect for the 160° trials was larger than for the 40° trials, $d_z = 0.33$. In the egocentric task, there was also only a significant main effect of Anchor, $F(1,15) = 32.87$, $p < .001$, $\eta_p^2 = .69$. The pattern, however, was different in this condition as indicated by an almost significant two-way interaction, $F(1,15) = 3.72$, $p = .073$, $\eta_p^2 = .20$. Figure 10 shows this three-way interation.

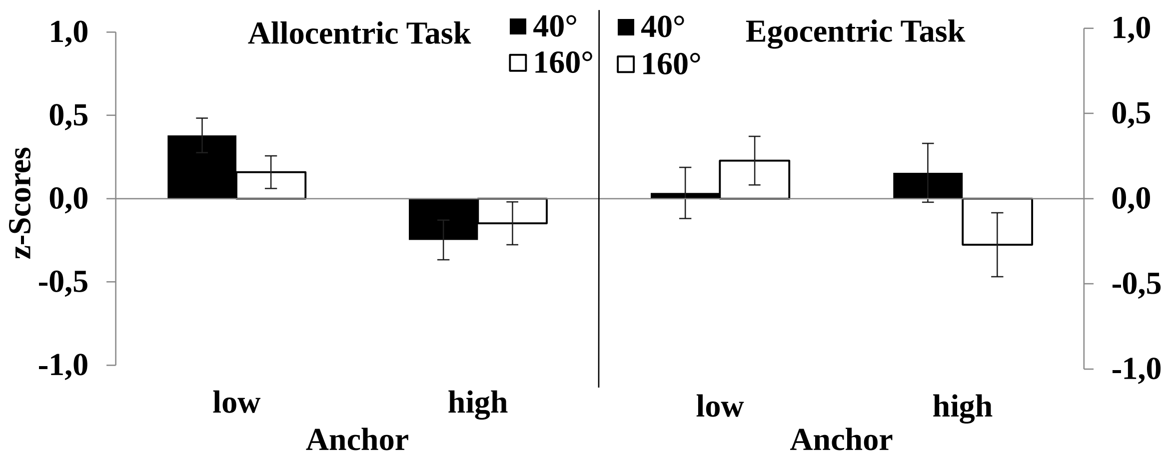
Figure 10. The anchoring effect as a function of the task and angular disparity.



Note. Error bars represent +/- 1 *SEM*.

Anchoring differences. Also for the anchoring differences, there was a significant main effect of Anchor, $F(1,51) = 8.65$, $p = .005$, $\eta_p^2 = .15$, which was qualified by a significant three-way interaction, $F(1,51) = 5.81$, $p = .020$, $\eta_p^2 = .10$. To specify this interaction, separate two-way ANOVAs were computed for the egocentric and the allocentric task. In the allocentric task, there was only a significant main effect of Anchor, $F(1,35) = 11.31$, $p = .002$, $\eta_p^2 = .24$. Although a significant two-way interaction was expected, the interaction term was not statistically significant, $F(1,35) = 1.99$, $p = .167$, $\eta_p^2 = .05$. However, the pattern of results resembled that of the first two experiments: participants provided estimations that were nominally closer to the provided anchor on 160° trials than on 40° trials. In the egocentric task, no significant effect was found, although the interaction between Anchor and Perspective came close, $F(1,16) = 4.40$, $p = .052$, $\eta_p^2 = .22$. However, in this condition participants by trend provided estimations further away from to the judgmental anchor on 160° trials. Figure 11 again shows the three-way interaction observed in this analysis.

Figure 11. Standardized differences between participants' judgments and the provided anchor as a function of the task and angular disparity.



Note. Error bars represent +/- 1 SEM.

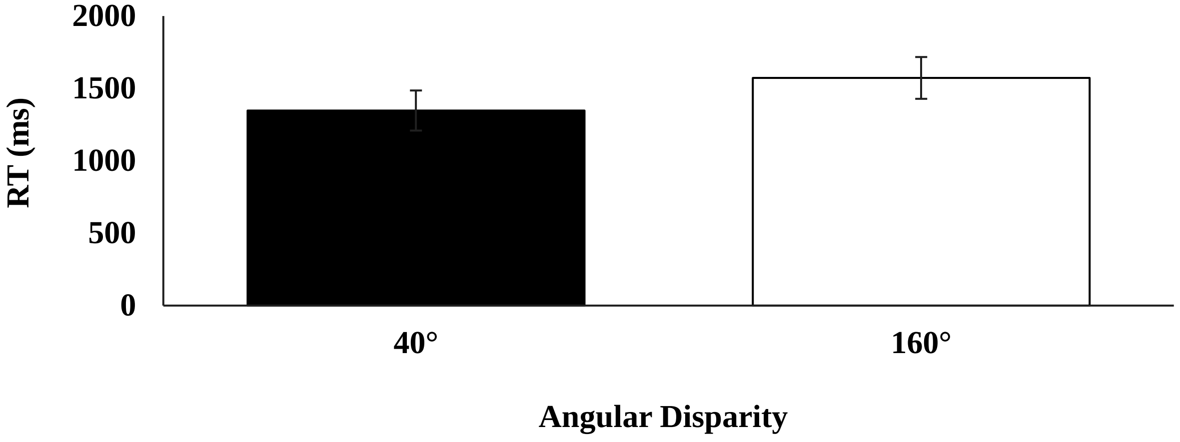
Additional analyses. Before discussing this experiment in detail, some additional analyses were conducted to address the high error rates on the visuo-spatial perspective-taking task. These errors were not evenly distributed across all cells of the design. For 40° of angular disparity, the error rates were 9.88% and 14.89%, respectively, in the allocentric and egocentric task condition, and 16.28% at 160° of angular disparity in the allocentric task. At 160° of angular disparity in the egocentric task, however, participants had an error rate of 63.83%. This distribution deviates significantly from expectation assuming a uniform error distribution, $X^2(1) = 6.86$, $p = .009$. Furthermore, this high number of errors was not distributed equally over the participants within the egocentric condition, as indicated by a Kolmogorov-Smirnov Test, $Z = 2.33$, $p < .001$. Some participants committed exclusively errors, whereas others committed none. Whereas the error distribution at 160° angular disparity was positively skewed ($\alpha_3 = 1.34$) in the allocentric task with a mode of *Mo* = 0, the error distribution for the egocentric task at 160° angular disparity was negatively skewed ($\alpha_3 = -0.45$) with a mode of *Mo* = 4. This shows that apparently some participants had trouble inhibiting the allocentric perspective in the egocentric task. To explore this in more detail, the sample was divided into three sub-groups ($n = 2$ participants made too many errors to be included in any group): these groups were, (1) the allocentric perspective-taking task ($n = 43$), (2) participants in the egocentric task condition who made no mistakes at 160° angular disparity ($n = 19$), and (3) participants of the egocentric task condition who predominantly committed errors at 160° angular disparity ($n = 26$). Next, correlations between the number of errors and the RT were computed.

At 40° of angular disparity, there was an overall positive correlation between errors and RTs, $r(88) = .28$, $p = .008$, which was present in the allocentric condition, $r(41) = .33$, $p = .034$, and although not significantly so, also in the truly egocentric subsample, $r(17) = .33$, $p = .174$, and for participants who were unable to solve the egocentric task at 160° angular disparity, $r(24) = .199$, $p = .330$. There was also a positive correlation at 160° angular disparity for the allocentric task condition, $r(41) = .60$, $p < .001$. Taken together, this suggests a general positive relation between errors and RT. For participants who committed many errors in the egocentric condition, however, this correlation was reversed at 160° of angular disparity, $r(24) = -.31$, $p = .128$. This negative correlation strongly supports the idea that these participants completed the egocentric task in an allocentric fashion. Presumably, for this subsample faster RTs correlated with higher accuracy, too. Since, however, a in their mind correct response was coded as an error, the arithmetic sign of the correlation flipped from positive to negative. Finally, there was no correlation between mean RT and error rate for the truly egocentric participants at 160° of angular disparity, $r(17) = -.09$, $p = .713$. This is in line with the assumption that these participants first had to inhibit the allocentric perspective before they could complete the task. Under this assumption, no correlation would be expected because both very fast and very slow responses likely lead to errors. But although also for these participants 160° trials were more difficult than 40° trials, these participants completed the egocentric task egocentrically.

Based on this reasoning, a set of additional ANOVAs was computed. For these analyses, participants of the egocentric condition who completed all 160° trials allocentrically were labeled “inadvertent allocentric” and were combined with the allocentric condition to one sample of all participants who solved (whichever task) allocentrically. For the inadvertent perspective-takers, errors rather than the correct responses at 160° were analyzed because they represent the “correct” solution of the perspective-taking task assuming that it was completed allocentrically. Comparisons between the allocentric and the “inadvertent allocentric” condition on all three dependent measures (RT, anchoring effect, or anchoring differences) yielded not any significant difference between the two subsamples, all Fs < 0.58, all ps ≥ .451, which further justifies the decision to combine them for the additional analyses. This combined sample was then compared with the egocentric participants in three 2 (Perspective-taking: allocentric (i.e., allocentric plus “inadvertent allocentric” participants) vs. egocentric; between) x 2 (Angular Disparity: 40° x 160°; within) x 2 (Anchor: high vs. low; within) ANOVAs.

Visuo-spatial perspective-taking. For the visuo-spatial perspective-taking task, this analysis now yielded a significant main effect of Angular Disparity, $F(1,78) = 4.57$, $p = .036$, $\eta_p^2 = .06$, which was not present in the original analysis. The average RT was significantly higher at 160° compared to 40° of angular disparity. This was expected for the allocentric participants, and replicates the prior studies, albeit with a smaller effect size. As discussed previously, the most compelling interpretation of this main effect (rather than an interaction between Angular Disparity and Perspective-taking) is that participants in the egocentric task needed to inhibit the foreign perspective, which is in line with prior research (Samson et al., 2010; B. Tversky & Hard, 2009). This led some of the participants to adopt an allocentric reference frame (i.e., "inadvertent alloentric" participants), whereas it increased reaction times at 160° for the remaining participants, who stood up to the difficulty of inhibiting the allocentric perspective and completed the task in a truly egocentric fashion. This is depicted in Figure 12.

Figure 12. Reaction times of the visuo-spatial perspective-taking task.

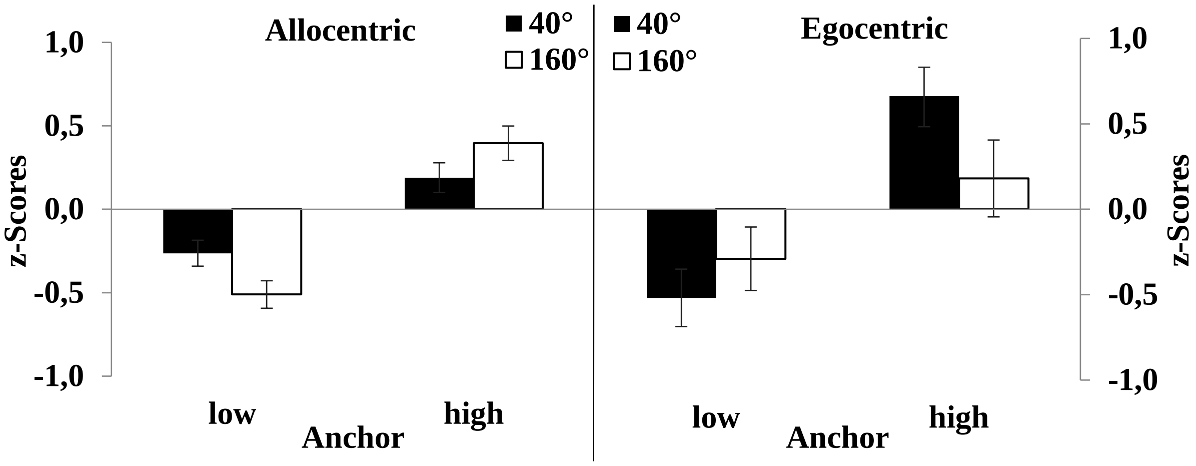


Note. Error bars represent +/- 1 *SEM*.

Anchoring effect. For the anchoring effect, the ANOVA yielded a significant main effect of Anchor, $F(1,75) = 55.70$, $p < .001$, $\eta_p^2 = .43$, and a significant three-way interaction, $F(1,75) = 9.32$, $p = .003$, $\eta_p^2 = .11$. To specify this three-way interaction, separate two-way ANOVAs were computed for the allocentric and the egocentric perspective-takers, respectively. The results of the egocentric perspective-takers were already discussed above (see Figure 10). For the allocentric perspective-takers, there was a significant main effect of Anchor, $F(1,60) = 50.11$, $p < .001$, $\eta_p^2 = .46$, as well as a significant Anchor x Angular Disparity interaction, $F(1,60) = 7.12$, $p = .010$, $\eta_p^2 = .11$. This pattern of results largely resembled that of the first two experiments and the original analysis. The three-way interaction is depicted in Figure 13.

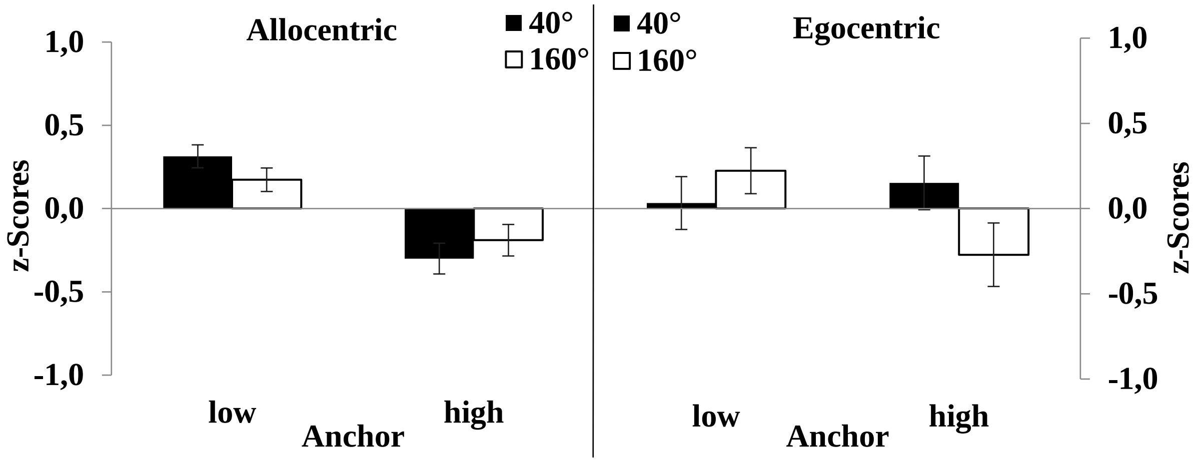
Anchoring Differences. Finally, the ANOVA for the anchoring differences also yielded a significant main effect of Anchor, $F(1,76) = 12.17$, $p = .001$, $\eta_p^2 = .14$, which was qualified by a significant three-way interaction, $F(1,76) = 5.82$, $p = .018$, $\eta_p^2 = .07$. To specify this interaction, separate two-way ANOVAs were computed for the egocentric and allocentric perspective-takers. The results of the egocentric perspective-takers were already discussed above (see Figure 11). For the allocentric perspective-takers, the ANOVA revealed only a main effect of Anchor, $F(1,60) = 26.39$, $p < .001$, $\eta_p^2 = .31$. The two-way interaction was not statistically significant, $F(1,59) = 2.18$, $p = .146$, $\eta_p^2 = .04$, but the pattern again resembled that of the first two studies. The results are shown in Figure 14.

Figure 13. The anchoring effect as a function of perspective-taking and angular disparity.



Note. Error bars represent +/- 1 SEM.

Figure 14. Standardized differences between participants' judgments and the provided anchor as a function of perspective-taking and angular disparity.



Note. Error bars represent +/- 1 SEM.

Discussion. To summarize, Experiment 3 was designed to rule out possible confounding aspects of the stimulus materials. Therefore participants completed either an egocentric or an allocentric version of the visuo-spatial perspective-taking task. If the effects of Experiments 1 and 2 were due to some feature of the stimulus material, they should be evident in both of these tasks. Although the results are less conclusive overall, a significant three-way interaction was observed on all measures of psychological perspective-taking. While the effects of the first two experiments were (nominally) replicated in the allocentric task, the results of the egocentric condition were diametrically different. Although the significant effects in the opposite direction should be interpreted with caution because of the very small remaining sample size in this condition, even a null result would speak against the idea that the previously observed effects are due to features of the stimuli. Therefore, although the results overall are less straightforward than in the first two experiments, stimulus effects still can be ruled out with confidence.

In addition to answering this question, an interesting, yet unexpected, effect was observed in the egocentric task. Namely, a large portion of the participants made many mistakes specifically on 160° angular disparity trials and the pattern of RTs on the visuo-spatial perspective-taking task did not differ between the egocentric and allocentric task. On both tasks, reactions were slower at 160° of angular disparity compared to 40° of angular disparity. Based on the additional analyses, this likely reflects spontaneous allocentric perspective-taking (cf. Samson et al., 2010; B. Tversky & Hard, 2009). Whereas some participants successfully were able to do inhibit this spontaneous allocentric perspective before rendering their judgment, thereby increasing their RTs, others were not able to do so and completed the task effectively allocentrically thereby committing errors specifically at 160° of angular disparity.

Although not the immediate focus of the experiment, this result underlines the potency of perspective-taking in everyday life: people tend to take foreign perspectives quite automatically when the opportunity arises. Although beyond the scope of the present thesis, future research should further investigate under which conditions perspective-taking is especially likely or whether certain personality traits are related to more automatic perspective-taking. Before such grand implications for everyday life should be discussed, however, it was important to rule out task difficulty which could not be convincingly ruled out as an alternative explanation for the enhancement of the anchoring effect in Experiment 3.

Experiment 4: The Role of Task Difficulty

The fourth experiment addressed the role of task difficulty for the observed effects. Although brought about by different means, task difficulty differed between 40° and 160° angular disparity trials in both conditions of Experiment 3. In the allocentric task, this was because only at 160° an embodied self-rotation has to be performed to solve the perspective-taking task whereas answers can be directly computed at 40° of angular disparity. In the egocentric task, this was due to the fact that participants apparently had to inhibit the allocentric perspective which was automatically computed at first before they rendered their judgments.

To this end, Experiment 4 introduced another control task where task difficulty also differed between 40° and 160° of angular disparity, but where no perspective-taking occurred. If the previous effects were due to task difficulty, the anchoring effect should also be affected in this task. If, however, the previous effects were due to visuo-spatial perspective-taking, the anchoring effect should not differ between 40° and 160° of angular disparity.

Methods. To achieve equal task difficulty, a *non-social perspective-taking task* was conceived and compared to the previously implemented perspective-taking task (here called *social perspective-taking task*). It was expected that the anchoring effect on the social task is larger at 160° of angular disparity (as in Experiments 1-3) and that the differences between participants' judgments and the numerical anchor are smaller at 160° of angular disparity. For thee non-social task, no difference between 40° and 160° of angular disparity were expected. Finally, for the RT analysis only a main effect of angular disparity and no interaction between the tasks was expected because the tasks were developed to exhibit equal task difficulty.

Social perspective-taking task. The social perspective-taking task was completely identical to the paradigm of Experiment 1 (see Appendix D for the instructions).

Non-social perspective-taking task. The non-social task shared the same basic procedural details as the social task of this experiment with only two crucial differences. First, the person was removed from the pictures and instead an empty chair was displayed (see Appendix F for the stimuli). This was done to create a non-social situation where no psychological perspective-taking occurs. Prior research has shown that even without a target person, spatial perspective-taking and the same embodied self-rotation happen (see, e.g., Kessler & Thomson, 2010; May, 2004; Michelon & Zacks, 2006). Furthermore, removing the avatar makes the task – if anything – more difficult (Kessler & Thomson, 2010; Exp. 2). The crucial difference between this condition and the prior experiments was that instead of an embodied self-other merging only an embodied self-rotation would occur.

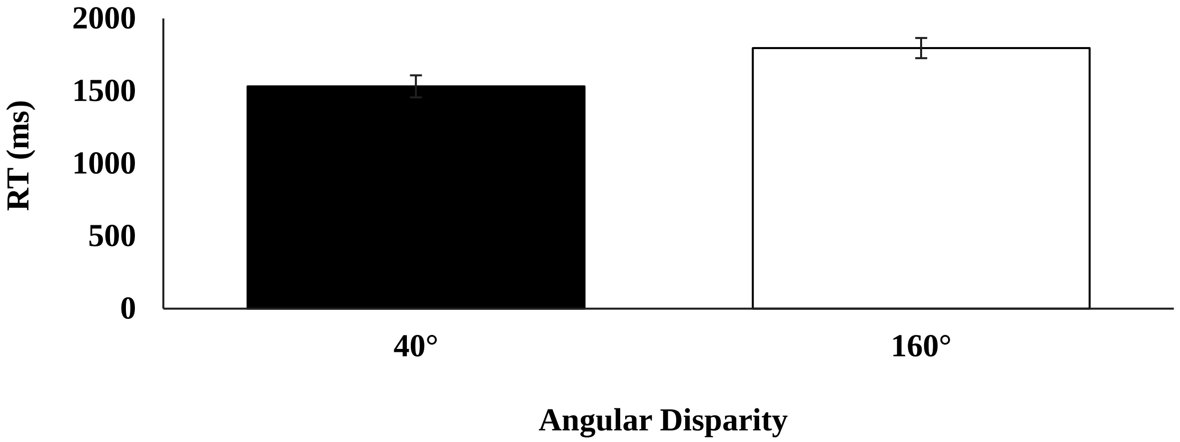
This procedural change furthermore made it necessary to provide the numerical anchor by a different means. Therefore, in the non-social condition the paradigm used by Strack and Mussweiler (1997) was adopted. In this paradigm participants first answer a comparative question (i.e., “is the cathedral of Cologne taller or less tall than X meters?”; see Appendix D for the instructions). This question provided the numerical anchor for participants’ judgment in the absence of another social agent. Since the comparative statement was only presented after the visuo-spatial perspective-taking task was already completed, it could not increase or decrease neither task difficulty nor the self-rotation per se. Although task difficulty was equal between conditions, it was conceivable that the “classic” anchoring paradigm would yield larger anchoring effects because here hypothesis confirming thoughts, one main mechanism of the anchoring effect (Mussweiler & Strack, 1999a, 1999b; Strack & Mussweiler, 1997), are directly instigated whereas this is not the case for the personalized anchoring paradigm. In spite of a potentially larger main effect, the relative difference between 40° and 160° of angular disparity which was expected for the social task, however, should not be present in the non-social task.

Sample. $N = 218$ people ($n = 139$ female, $n = 69$ male, $n = 10$ missing; $M_{age} = 21$, $SD = 4$) participated. Due to technical problems, data of $n = 20$ participants were lost. Participants were recruited at the university cafeteria and participated in a separate room in sessions of up to ten participants. As compensation, they received a candy bar. It took about 10 minutes to complete this experiment and another experiment which was run after it in the same session.

Results. A 2 (Anchor: high vs. low; between) x 2 (Task: social vs. non-social; between) x 2 (Angular Disparity: 40° vs. 160°; within) mixed models ANOVA was computed for all three dependent variables. $n = 11$ participants failed to follow the anchoring task instructions and consistently typed letter strings instead of estimations into the text box. These data obviously could not be analyzed. No further participants were excluded.

Visuo-spatial perspective-taking. As in the previous studies and as expected, the ANOVA yielded only a significant main effect of Angular Disparity, $F(1,194) = 12.89$, $p < .001$, $\eta_p^2 = .06$. All other effects were statistically not significant. Particularly effects involving the task manipulation were not significant, which shows that the two tasks were equal regarding their task difficulty and that the increase in task difficulty between 40° and 160° of angular disparity was equal as well (all Fs < 2.26, all ps ≥ .135). Figure 15 shows this main effect.

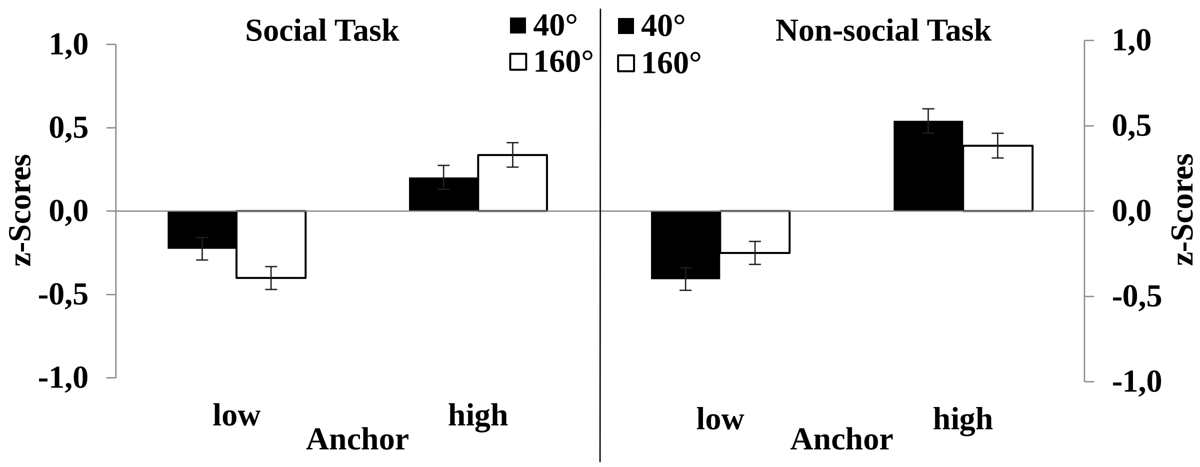
Figure 15. Reaction times of the visual perspective-taking task.



Note. Error bars represent +/- 1 Standard Error of Means (*SEM*).

Anchoring effect. As expected, there was a significant anchoring effect, $F(1,183) = 165.63$, $p < .001$, $\eta_p^2 = .48$, which was qualified by a significant three-way interaction, $F(1,183) = 11.14$, $p = .001$, $\eta_p^2 = .06$. To specify this interaction, separate two-way ANOVAs were computed for the social and the non-social task, respectively. The social task again replicated the results of the first three studies: there was a significant anchoring effect in this condition, $F(1,90) = 57.36$, $p < .001$, $\eta_p^2 = .39$, which was qualified by a two-way interaction, $F(1,90) = 6.33$, $p = .014$, $\eta_p^2 = .07$. The anchoring effect was again enhanced at 160° ($d = 1.56$) compared to 40° of angular disparity ($d = 0.91$). Surprisingly, in the non-social anchoring task an opposite pattern was observed instead of a null-effect. There was also a significant anchoring effect in this condition, $F(1,93) = 114.81$, $p < .001$, $\eta_p^2 = .55$, which was qualified by a two-way interaction, $F(1,93) = 4.96$, $p = .028$, $\eta_p^2 = .05$. The anchoring effect was enhanced at 40° ($d = 1.93$) compared to 160° of angular disparity ($d = 1.27$) in this condition. Although no significant difference was expected in this condition, this result still supports the idea that task difficulty cannot account for the enhancement of the anchoring effect after visuo-spatial perspective-taking because the anchoring effect was enhanced for the easier trials of the non-social task. Figure 16 depicts the three-way interaction.

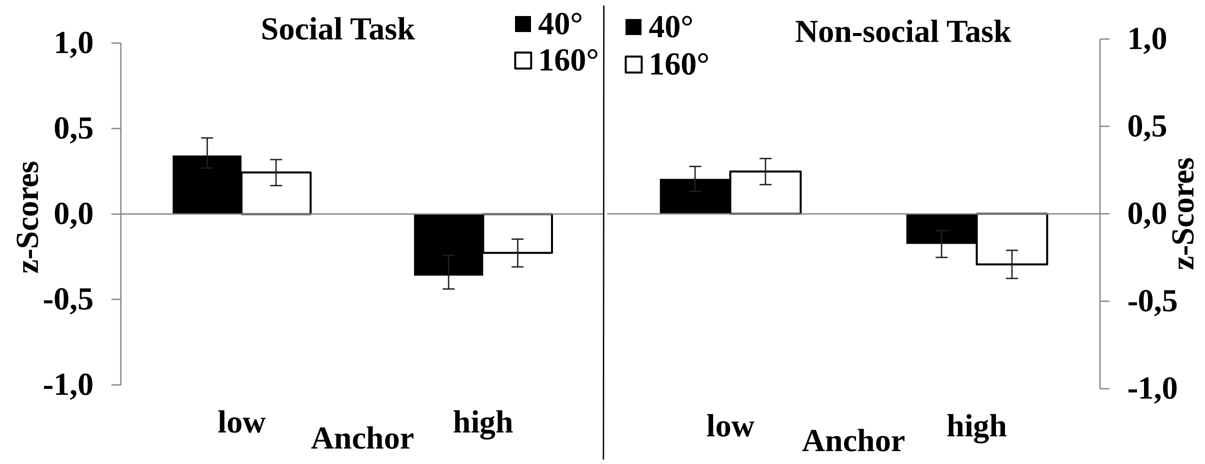
Figure 16. The anchoring effect as a function of the task and angular disparity.



Note. Error bars represent +/- 1 *SEM*.

Anchoring differences. In this analysis there was a only a significant main effect of anchor, $F(1,183) = 83.70$, $p < .001$, $\eta_p^2 = .31$. The predicted three-way interaction was barely not significant, $F(1,183) = 3.64$, $p = .058$, $\eta_p^2 = .02$. Nonetheless, to parallel the anchoring effect analysis separate ANOVAs were computed for the two tasks. For the social task there was a significant main effect of anchor, $F(1,90) = 60.56$, $p < .001$, $\eta_p^2 = .40$, and again an almost significant two-way interaction, $F(1,90) = 3.44$, $p = .067$, $\eta_p^2 = .04$, which resembled the pattern of the prior studies. The difference between participants' judgments and the estimations of the target person was smaller at 160° of angular disparity. For the non-social task there was only a significant main effect of anchor, $F(1,93) = 28.54$, $p < .001$, $\eta_p^2 = .24$. The interaction was far from statistical significance, $F(1,93) = 0.97$, $p = .327$, $\eta_p^2 = .01$. The difference between participants' judgments and the numerical anchor provided in a comparative statement therefore was not modulated by visuo-spatial perspective-taking. These results are plotted in Figure 17.

Figure 17. Standardized differences between participants' judgments and the provided anchor as a function of the task and angular disparity.



Note. Error bars represent +/- 1 *SEM*.

Discussion. The results of Experiment 4 were largely in line with its predictions. The social task replicated the first three experiments although the anchoring differences analysis was statistically (barely) non-significant. The anchoring effect was enhanced and participants' judgments were more similar at 160° of angular disparity.

The non-social task exhibited diametrically different results. There was a strong anchoring affect in this condition, which unexpectedly was larger at 40° of angular disparity. The differences between participant and target judgments, on the other hand, were not affected at all by angular disparity. One possibility for the enhanced anchoring effect in this condition is that in a standard anchoring paradigm task difficulty indeed affects the anchoring effect albeit in the opposite direction than anticipated. Possibly cognitive load created by the visuo-spatial perspective-taking task interfered with the generation of hypothesis confirming information. Therefore, judgmental biases were more pronounced at 40° of angular disparity where task difficulty was low and more capacity for hypothesis confirmatory reasoning was available. Whatever the reason for this opposite effect, it still speaks against the idea that task difficulty causes the observed effects on the personalized anchoring paradigm because the two tasks were largely identical in terms of reaction times and errors (i.e., task difficulty). Thus, task difficulty can also be ruled out as an explanation of the results of Experiments 1-4. Thus, after ruling out several possible confounds of the observed effects, the final studies went on to provide positive evidence for a unitary view of perspective-taking.

Experiment 5: The Embodiment of Psychological Perspective-taking

The fifth experiment addressed the role of embodiment for the observed effects. To this end, the angular disparity between participant and target was varied continuously rather than dichotomously in this study. Based on prior it is known that 80° of angular disparity is the threshold after which embodiment effects in visuo-spatial perspective-taking paradigms occur (Janczyk, 2013; Kessler & Rutherford, 2010; Kessler & Thomson, 2010). In these prior studies participants' body posture was manipulated orthogonally to angular disparity. This was done by either turning participants' body 60° towards or away from the target in the picture. By means of this, the angular disparity which the embodied transformation had to cover was increased or decreased, respectively. As a result, RTs were modulated by congruence or incongruence of participants' body schema which the authors interpreted as embodiment effects (Kessler & Rutherford, 2010; Kessler & Thomson, 2010) and this modulation happened only at angular disparities of 80° and higher because only for these angular disparities the visuo-spatial frames of reference between participant and target differ. No embodiment effects were observed below 80° because there participants can use a direct matching strategy to locate the object from the target's point of view which at these angles matches their own egocentric visual reference frame (see, e.g., Graf, 1994; Janczyk, 2013; Keehner et al., 2006; Kessler, 2000).

Extending these findings to psychological forms of perspective-taking, increased anchoring effects and decreased differences to the provided anchors should only be observed at the higher levels of angular disparity (i.e., 80°-160°), but not at the lower levels (i.e., 0°-40°).

Methods. Participants again completed the visuo-spatial perspective-taking task as in Experiments 1-4 which was followed by the same personalized anchoring paradigm. Instead of using only 40° and 160° pictures, angular disparity was manipulated continuously in steps of 40° (see Appendix E for the stimuli). Participants completed four trials on every level of angular disparity, resulting in twenty total trials per participant. The anchor variable was again manipulated between participants. Thus, the study had a 2 (Anchor: low vs. high; between) X 5 (Angular Disparity: 0° vs. 40° vs. 80 vs. 120° vs. 160°; within) design.

Sample. N = 227 people (n = 160 female, M_{age} = 27, SD = 11) participated in exchange for €7. The study took approximately 10 minutes to complete.

Pilot test. Since the number of trials was increased to twenty, new anchoring items had to be generated. Therefore, N = 141 participants (n = 99 female, M_{age} = 27, SD = 9) were recruited for a pilot study during which they answered twenty-four trivia questions on a variety of topics (see Appendix B for the items and complete results). For every question the 15th and 85th percentile were calculated as potential judgmental anchors (as in, e.g., Mussweiler &

Strack, 1999a; Mussweiler & Strack, 1999b; Strack & Mussweiler, 1997). Twelve items with appropriate distributions were selected and added to the eight existing items (see Appendix C).

Hypotheses. Based on the abovementioned considerations three contrast vectors were formulated and applied to the respective analyses. The general linear analyses of the interaction term without contrasts was not informative for this study because no linear increase in the dependent measures was anticipated.

RTs. For the RT analyses, two contrast vectors for the main effect of Angular Disparity were coded because no effect of the judgmental anchor on RTs was expected. The first contrast assumes a jump of mean RTs at 120° of angular disparity. This contrast is in line with prior research on visuo-spatial perspective-taking (Janczyk, 2013).

$$Contrast\ I\ for\ the\ Angular\ Disparity\ main\ effect:$$

$$(-2; -2;\ -2;\ 3;\ 3)$$

Alternatively, this jump could happen already at 80° angular disparity, too, because prior research was only able to determine that RTs increase somewhere between 60° and 90° angular disparity. Visually inspecting the stimulus material, 80° angular disparity is the angle at which the spatial relations between the objects, the target person, and the participant already start to change. Therefore, this second, stimulus-based contrast was coded:

$$Contrast\ II\ for\ the\ Angular\ Disparity\ main\ effect:$$

$$(-3; -3;\ 2;\ 2;\ 2)$$

Note that the embodiment account is agnostic about the RTs because it does not predict task-difficulty to be relevant for the effects on the psychological dependent variable (see also Experiment 4). However, its prediction for the psychological dependent variable are parallel to the second contrast vector. Therefore, if such a pattern of results would surface for both the RT and the anchoring effect analyses, task difficulty would have to be considered as a parallel explanation of the results of Experiment 5. Note, however, that Experiment 4 already directly ruled out task difficulty as the driving force of the observed effects.

Anchoring effect. For the anchoring effect, a contrast matrix for the Anchor (low; high) X Angular Disparity (0°; 40°; 80°; 120°; 160°) interaction was coded. Based on the embodied self-rotation account, embodied self-other merging only happens at 80° angular disparity and upwards (Kessler & Rutherford, 2010; Kessler & Thomson, 2010). Thus the anchoring effect was expected to be larger at these levels (80°, 120°, and 160°) compared to the other two levels.

$$Contrast\ for\ the\ Anchor\ x\ Angular\ Disparity\ interaction:$$

$$[(-1;\ 1)\ X\ (-3; -3;\ 2;\ 2;\ 2)]$$

Difference to the provided anchor. Finally, based on the prior studies the contrast matrix coded for the difference to the provided anchors was the inverse of the anchoring effect contrast matrix. This contrast predicts that the difference between participants' judgments and the provided anchors are smaller at 80°, 120°, and 160° compared to 0° and 40° of angular disparity.

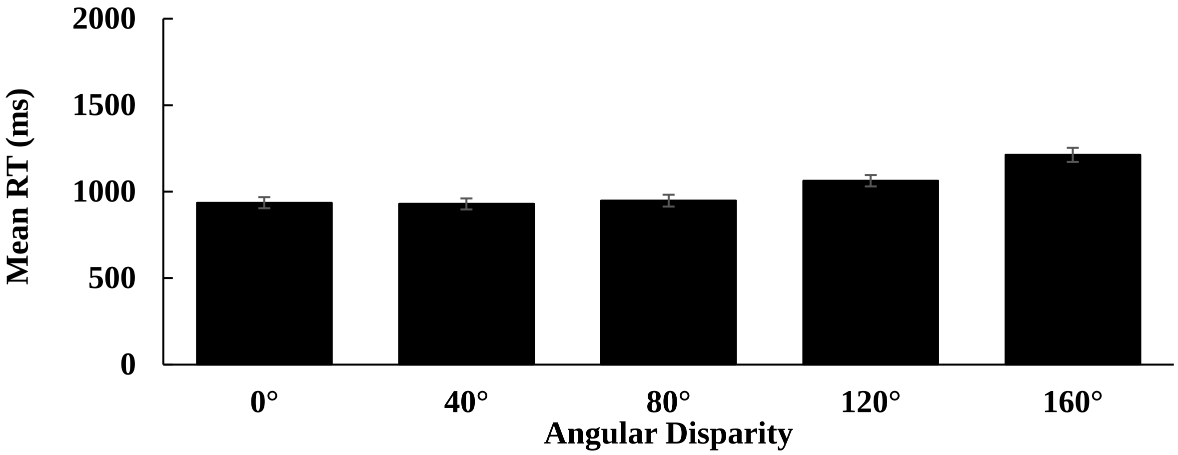
$$Contrast\ for\ the\ Anchor\ x\ Angular\ Disparity\ interaction:$$

$$[(-1;\ 1)\ X\ (-3; -3;\ 2;\ 2;\ 2)]$$

Results. The data were prepared as in the previous studies. But instead of a general linear model, the data was submitted to specific contrast analyses (see above).

Visual perspective-taking. For the RTs, both contrasts for the main effect of Angular Disparity yielded a significant result, but the first contrast, $F(1,225) = 87.46$, $p < .001$, $\eta_p^2 = .28$, fit the data better than the second contrast, $F(1,225) = 38.61$, $p < .001$, $\eta_p^2 = .15$. RTs were very similar between 0° and 80° of angular disparity and increased only starting at the 120° level. These results, which are in line with prior research (Janczyk, 2013; Kessler & Thomson, 2010; Popescu & Wexler, 2012; Zacks & Michelon, 2005), are depicted in Figure 18.

Figure 18. Reaction times of the visual perspective-taking task.

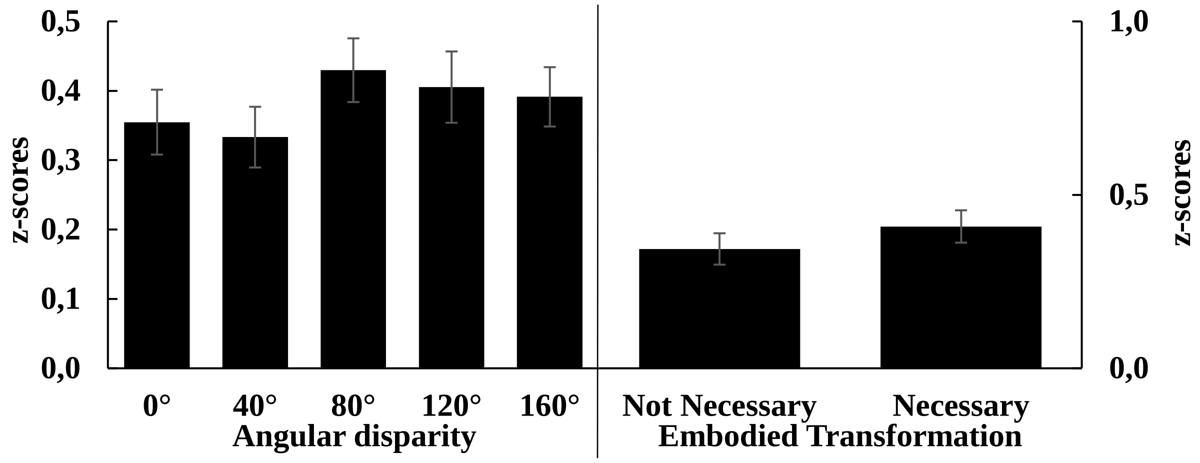


Note. Error bars represent +/- 1 SEM.

Anchoring effect. The contrast analysis of the anchoring effect yielded a significant result, $F(1,225) = 5.42$, $p = .021$, $\eta_p^2 = .02$. This supports the embodied transformation hypothesis: only when an embodied self-rotation into the target's perspective is performed, the thoughts of that person are adopted, too. The results further support Experiment 4 and show that this increase is independent of task difficulty. Descriptively, the effects were even strongest at 80° of angular disparity – the level that is equivalently difficult as the non-embodiment levels of angular disparity. These results are shown in Figure 19.

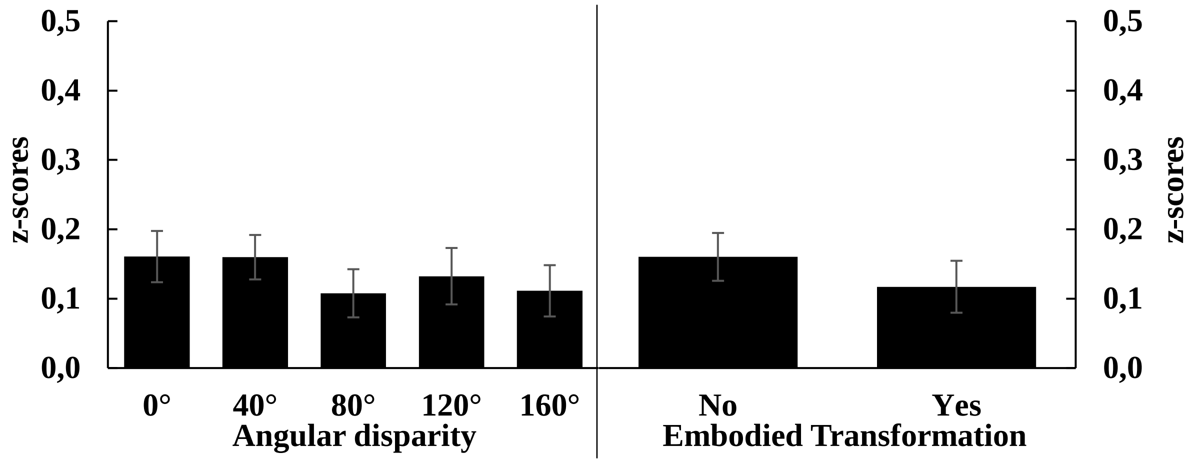
Anchoring differences. Again, the predicted contrast for the Anchor x Angular Disparity interaction on the anchoring differences yielded a significant result, $F(1,223) = 4.03$, $p = .046$, $\eta_p^2 = .02$. The differences between participants' and the target's estimations were smaller upwards of 80° angular disparity compared to the lower levels of angular disparity. This is again in line with the embodied transformation account and is shown in Figure 20.

Figure 19. The anchoring effect as a function of angular disparity (left) and embodied transformation (right).



Note. Error bars represent +/- 1 SEM.

Figure 20. Standardized differences between participants' judgments and the provided anchor as a function of angular disparity (left) and embodied transformation (right).



Note. Error bars represent +/- 1 SEM.

Discussion. Taken together, these results strongly support the embodied transformation account. Both the enhancement of the anchoring effect and the reduction of the differences between participants' judgments and the judgments of the target person were specific to angular disparities of 80° and upwards. This corresponds to the threshold for embodiment effects observed in prior research (Kessler & Rutherford, 2010; Kessler & Thomson, 2010).

In addition, Experiment 5 further rules out task difficulty as a potential explanation of these results. The continuous manipulation of angular disparity made it possible to assess task difficulty (indicated by mean RT at different levels of angular disparity) while simultaneously manipulating embodied transformation. Based on prior research it is known that difficulty and embodiment do not increase in parallel. Whereas RTs increase in a curvilinear fashion with a flat slope up until 80° and a steep increase after that (Janczyk, 2013; Kessler & Rutherford, 2010; Kessler & Thomson, 2010; Kessler & Wang, 2012; see also the present results), embodiment effects can be observed starting at 80° angular disparity (Kessler & Rutherford, 2010; Kessler & Thomson, 2010; Kessler & Wang, 2012; Surtees et al., 2013a, 2013b). Thus, especially the 80° angular disparity trials are informative in this regard. At 80° of angular disparity task difficulty is low but embodied self-rotation already occurs. This was both evident in the present data, too. RTs at 80° angular disparity were rather fast and comparable to the 0° and 40° angular disparity trials (i.e., the first contrast for the RT data had the highest predictive power). The anchoring effect and differences analyses, on the other hand, were modulated from 80° angular disparity on. Taken together the effects on these two dependent variables seem not to depend on an increase in task difficulty because in this case these psychological variables should be affected only upwards of 120° of angular disparity, too.

Having established the reliability of the effect of visuo-spatial perspective-taking on psychological perspective-taking across five experiments and its specificity to instances of embodied mental self-rotation, the next study went on to provide a validation of these results. In principle, it is still possible that the observed results are due to embodied self-other merging but that they are really independent of psychological self-other merging (cf. Aron et al., 1992).

Experiment 6: Embodied and Conceptual Self-other merging

After Experiment 5 established that the observed effects of visuo-spatial perspective-taking on psychological outcomes are specific to embodied self-other merging trials, the last experiment sought to show that this kind of merging is related to the what psychological perspective-taking researchers refer to as self-other merging (see, e.g., Batson, Early, et al., 1997; Batson, Polycarpou, et al., 1997; Batson, Sager, et al., 1997; Davis et al., 1996, 2004; Galinsky et al., 2005; Vorauer & Cameron, 2002). Although the personalized anchoring task phenomenologically comes very close to measuring “The ability to intuit another person’s thoughts, feelings, and inner mental states” (i.e., social psychologists' definition of psychological perspective-taking, cf. Epley & Caruso, 2009, p. 297), it is not an established measure of psychological perspective-taking. The final experiment added an assessment of self-other merging to validate the previously observed results as related to the central mediator of psychological perspective-taking effects.

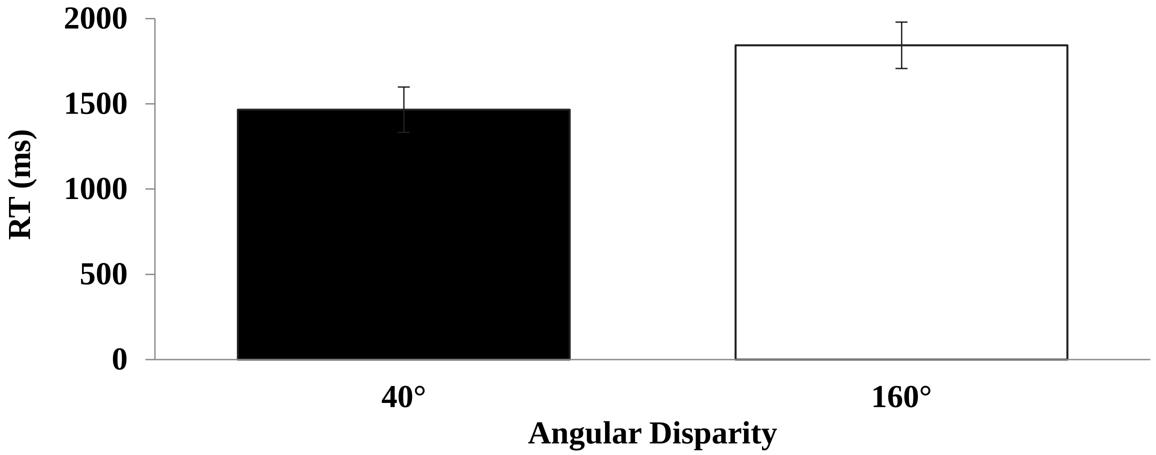
Methods. Experiment 2 was replicated with one change to the setup: before participants answered the trivia question, the question „How similar do you feel to this person right now?“ appeared on the screen and participants had to answer on a nine-point scale ranging from 1 (not similar at all) to 9 (very similar). This procedure is a verbal version of the inclusion-of-the-other-in-the-self scale by Aron et al. (1992). The similarity rating was assessed before the estimation task to rule out that similar estimations created heightened feelings of similarity.

Sample. N = 69 people (n = 35 female; M_{age} = 22, SD = 4) participated. They were recruited at the university cafeteria and participated in a separate room in exchange for a candy bar. It took participants about 5-10 minutes to complete this experiment.

Results. Data were subjected to the 2 (Angular Disparity: 40° vs. 160°; within) x 2 (Anchor: low vs. high; within) x 2 (Stimulus List; between) mixed models ANOVAs. In this experiment, n = 6 participants had to be excluded from the RT analysis, n = 8 participants were excluded from the other two main ANOVAs, and n = 11 participants were excluded from the similarity analysis (see Data Analysis).

Visuo-spatial perspective-taking. The reaction time analysis again yielded only a main effect of Angular Disparity, $F(1,60) = 19.43$, $p < .001$, $\eta_p^2 = .25$. As can be seen in Figure 21, participants' responses were again slower at 160° angular disparity. All other effects were not statistically significant, all *F*s < 2.08, all *p*s ≥ .155, all η_p^2s < .04.

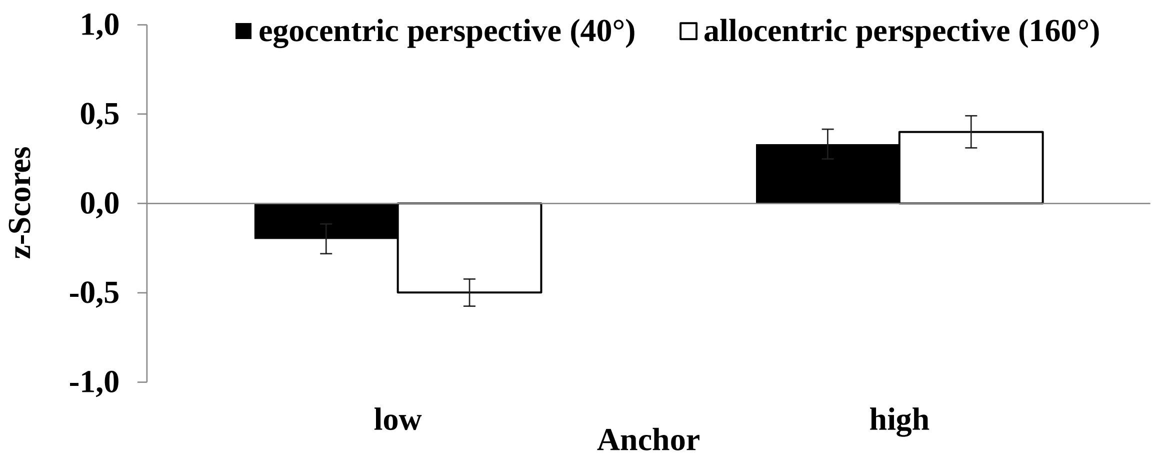
Figure 21. Reaction times of the visual perspective-taking task.



Note. Error bars represent +/- 1 *SEM*.

Anchoring effect. There was again a significant anchoring effect, $F(1,59) = 58.44$, $p < .001$, $\eta_p^2 = .50$, which was qualified by a significant two-way interaction between Angular Disparity and Anchor, $F(1,59) = 5.52$, $p = .023$, $\eta_p^2 = .09$. The anchoring effect for the 160° trials was increased by $d_z = 0.30$ compared to the 40° trials, see Figure 22.

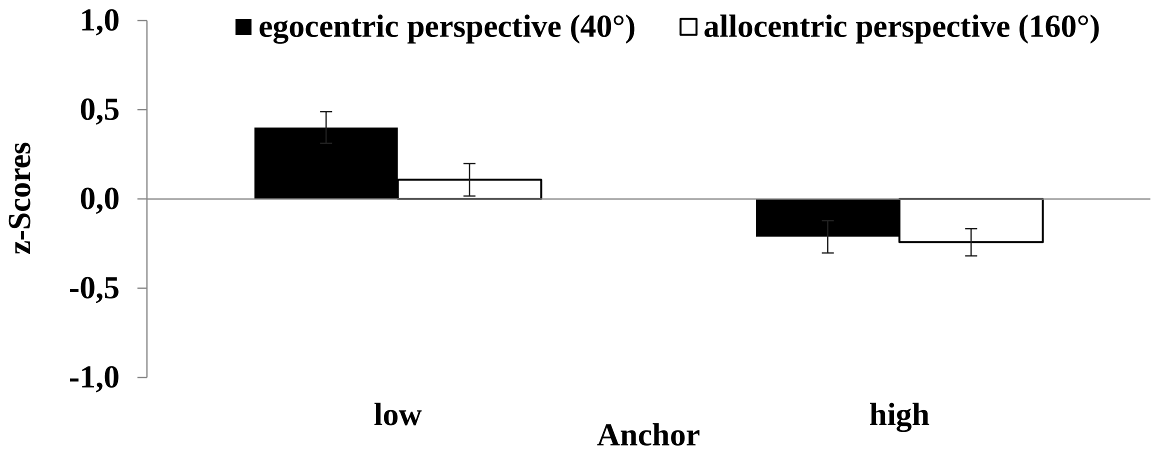
Figure 22. The anchoring effect as a function of angular disparity.



Note. Error bars represent +/- 1 *SEM*.

Anchoring differences. For the anchoring differences, there was again a significant main effect of anchor, $F(1,59) = 26.12$, $p < .001$, $\eta_p^2 = .31$, but no significant Angular Disparity X Anchor interaction, $F(1,59) = 2.65$, $p = .109$, $\eta_p^2 = .04$. But the pattern was again comparable to the prior experiments, that is, estimations were closer to the judgmental anchor on 160° trials than on 40°. These results are plotted in Figure 23.

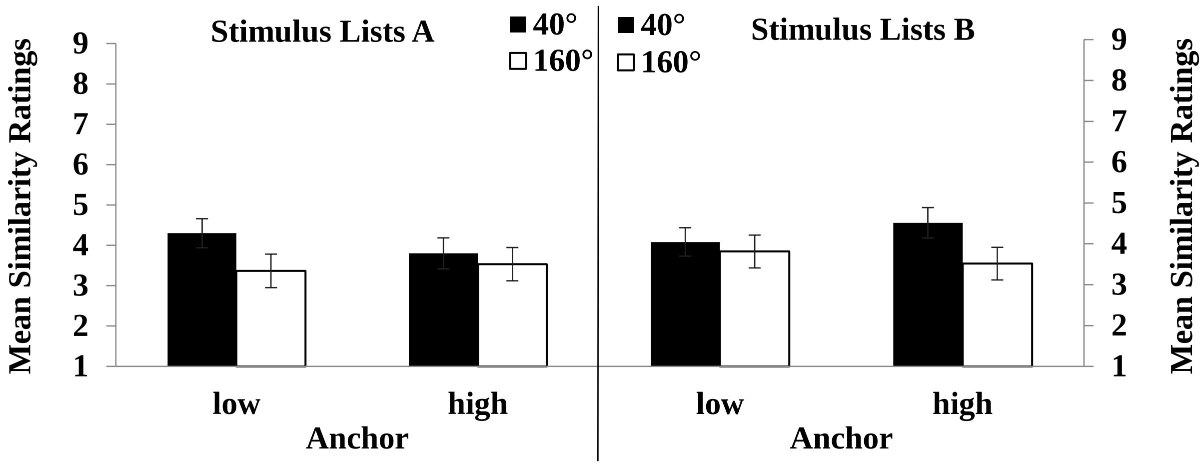
Figure 23. Standardized differences between participants' judgments and the provided anchor as a function of angular disparity.



Note. Error bars represent +/- 1 *SEM*.

Perceived similarity to the target. Finally, for perceived similarity there was a significant main effect of Angular Disparity, $F(1,56) = 8.31$, $p = .006$, $\eta_p^2 = .13$, as well as a three-way interaction between Angular Disparity, Anchor, and Stimulus List, $F(1,56) = 7.11$, $p = .010$, $\eta_p^2 = .11$. The three-way interaction stemmed from the fact that this difference was larger after low numerical anchors for stimulus list A, whereas it was larger following high numerical anchors for stimulus B. This interaction is theoretically irrelevant and therefore not discussed any further. More importantly, participants felt in general more similar to the targets sitting at 40° angular disparity ($M = 4.39$, $SD = 1.76$) than to targets sitting at 160° angular disparity ($M = 3.74$, $SD = 2.09$), $d_z = 0.38$. This was an unexpected finding because it was assumed that embodied self-other merging leads to a feeling of similarity which should lead to higher similarity ratings at 160° angular disparity. Figure 24 shows the three-way interaction.

Figure 24. Perceived similarity to the target person as a function of angular disparity, provided anchors, and stimulus list.



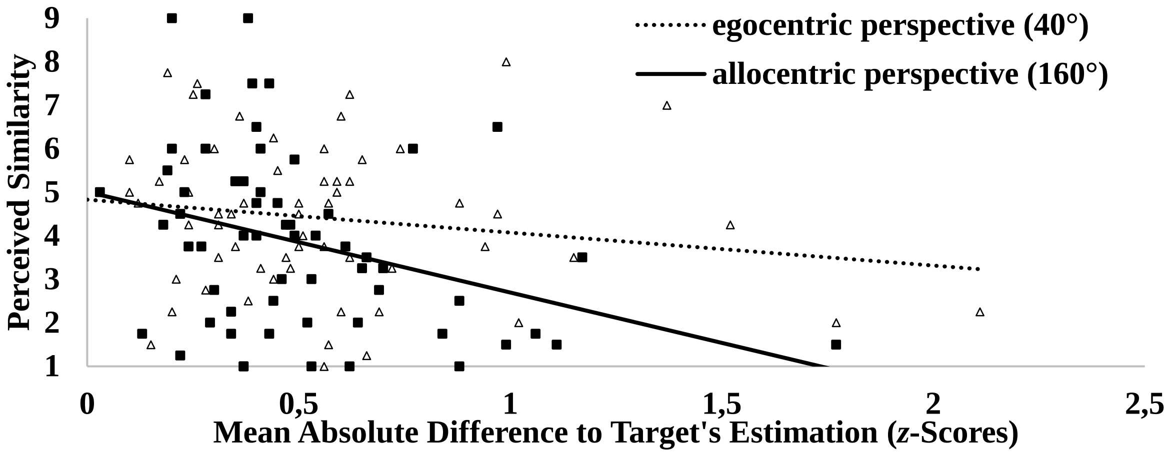
Note. Error bars represent +/- 1 *SEM*.

However, a mean difference alone is not sufficient to disqualify the embodied self-other merging account because it could result from other factors as well. For instance, the target at 40° angular disparity sits closer to the participant than the target at 160° angular disparity. As mentioned before, spatial and psychological distance are intimately linked (Trope & Liberman, 2010), which could increase perceived similarity at 40° of angular disparity. However, if perceived similarity were higher due to such an experiential process, the increase should be independent of the results on the anchoring task which are the result of simulative perspective-taking. At 160° of angular disparity, on the other hand, there should be a correlation between perceived similarity and the adoption of the target's estimations because both variables are increased because of embodied self-other merging. Further analyses tested this possibility.

Correlational analyses. First, zero-order correlations between participants' similarity ratings (averaged across low and high anchors) and the anchoring differences (transformed to absolute values and averaged across high and low anchors) were computed. A negative correlation between high feelings of similarity and smaller anchoring differences was expected. Although this correlation was predicted specifically for the allocentric perspective-taking trials because of embodied self-other merging, it is debatably whether one should assume no correlation at all for the egocentric trials. We generally agree more with people who we like or perceive to be similar to us (Cohen, 1977; Lazarsfeld & Merton, 1954; McPherson, Smith-Lovin, & Cook, 2001). Given the higher mean similarity ratings for the 40° angular disparity trials, a negative correlation also for these trials seems likely as well.

Both computed correlations were indeed negative. But whereas the correlation was not significant for 40° angular disparity, $r(62) = -.17$, $p = .185$, it twice as large and significant for 160° angular disparity, $r(60) = -.34$, $p = .008$. Figure 25 shows these correlations.

Figure 25. Raw data and correlation between perceived similarity and difference between estimations for egocentric and allocentric perspective-taking.



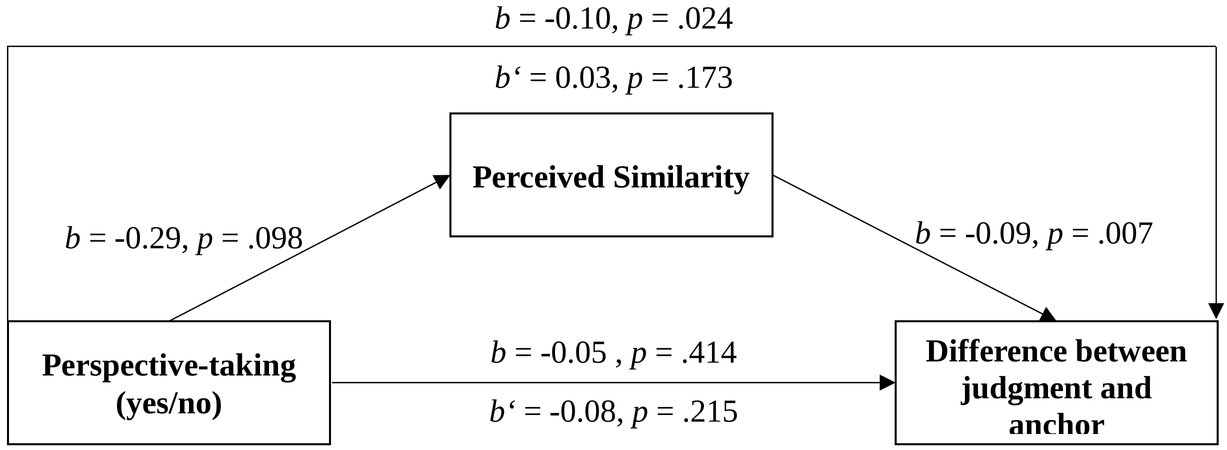
Notes. R^2(allocentric) = .12. R^2(egocentric) = .03.

These two correlations, however, did not differ significantly from each other, $Z = 0.98$, $p = .327$. As mentioned above, this was somewhat to be expected given the higher overall similarity ratings for 40° angular disparity. Furthermore, the general negative correlation across all trials ($r(67) = .33$, $p = .005$) shows that the personalized anchoring paradigm is related to the most important indicator of psychological perspective-taking effects: feelings of similarity to the target of perspective-taking (Batson, Early, et al., 1997; Batson, Sager, et al., 1997; Davis et al., 1996, 2004; Dovidio et al., 2004; Galinsky et al., 2005; Galinsky & Moskowitz, 2000) which emphasizes its validity as a psychological perspective-taking measure.

Mediation analyses. Second, a mediation model was computed to see whether there was an indirect effect of perspective-taking on the anchoring differences mediated by perceived similarity. To this end, the anchoring differences were regressed onto a dummy coded variable of perspective-taking (0 = egocentric/no perspective-taking (40° angular disparity); 1 = allocentric perspective-taking (160° angular disparity)), and *z*-standardized similarity ratings were entered as a mediator (following suggestions by Hayes, 2013; Preacher & Hayes, 2008).

This analysis yielded neither a significant direct effect of perspective-taking on anchoring differences, $b = -0.05$, $t(121) = -0.82$, $p = .414$, nor on perceived similarity, $b = -0.29$, $t(121) = -1.67$, $p = .098$. Although classic mediation literature states this as a necessary precondition for testing mediation (Baron & Kenny, 1986), more contemporary work suggests testing indirect effects independently as well (Hayes, 2009; Zhao, Lynch, & Chen, 2010). Indeed there was a direct effect of perceived similarity on anchoring differences, $b = -0.09$, $t(121) = -2.76$, $p = .007$. Furthermore, the indirect effect of perspective-taking over perceived similarity was a significant predictor of anchoring differences when analyzed individually, $b = -0.10$, $t(123) = -2.28$, $p = .024$. However, when embedded in the full mediation model including the main effects as covariates, there was no significant mediation, $b = 0.03$, $Z = 1.36$, $p = .173$. Likely, this was due to the large differences in perceived similarity between 40° and 160° angular disparity and the somewhat unsatisfactory sample size of Experiment 6. Figure 26 shows the full mediation model.

Figure 26. Full mediation model for the effect of visuo-spatial perspective-taking on estimation differences, mediated by perceived similarity.



Discussion. The results of Experiment 6 demonstrate that outcomes of the personalized anchoring paradigm are indeed related to a psychological state of self-other merging (Aron et al., 1992). Therefore, this newly developed measure of psychological perspective-taking is not only phenomenologically, but also empirically close to established measures of the construct. Furthermore, the correlation between participants' judgments and perceived similarity to the target was higher after visuo-spatial perspective-taking, although not significantly so.

The most proximal explanation for this lack of a difference is the comparatively low power of this experiment combined with the surprising mean difference in perceived similarity, which was higher at 40° of angular disparity than at 160°. In line with the introduction, this is potentially due to the parallel operation of an experiential process. As already elaborated in the introduction of Experiment 3, the 40° and the 160° stimuli differ in many other important regards, such as spatial (and psychological) distance between participant and target. Arguably, distance was even manipulated more strongly than embodied self-other merging in this experiment. However, although this led to increases in perceived similarity on a mean level, these were not related to the adoption of the thoughts of another person during the personalized anchoring paradigm. This further underlines the importance of not only looking at measurement outcomes to declare whether a task measures perspective-taking and if so which kind. Rather, it is important to test whether a change in, for instance, self-other merging is due to (simulative) perspective-taking or other (experiential or noetic) related processes.

On the flipside, this finding also demonstrates that one has to be careful about the processes which are instigated by perspective-taking manipulations. In this case, not only embodied self-other merging (i.e., a simulative process) but also an experiential process (i.e., closeness between target and participant) were manipulated. Unlike prior studies that supported a segregated view of perspective-taking using instruction manipulations (see, e.g., Batson, Early, et al., 1997; Davis et al., 1996, 2004; Fiske et al., 1979; Libby & Eibach, 2011b), these processes were at least dissociable on the dependent measures in Experiment 6. To further remedy this limitation of Experiment 6, Experiment 3 could be replicated with an additional assessment of self-other merging. However, in Experiment 3 participants inadvertently adopted allocentric perspectives although they were instructed against doing so. Therefore, a future study using matched stimuli and an assessment of self-other merging needs to make sure that participants complete the egocentric perspective-taking task in a truly egocentric fashion.

Summary of Results

Six experiments were conducted to test the embodied mental self-rotation account of psychological perspective-taking. The evidence convincingly demonstrates that visuo-spatial perspective-taking can indeed lead to psychological consequences, too.

The first hypothesis, that visuo-spatial perspective-taking would increase the anchoring effect in a personalized paradigm where the numerical anchor was provided as the mental state of another person was tested across all six experiments. It could be shown that whenever the visuo-spatial perspective-taking task required an embodied rotation of the self, the anchoring effect was enhanced. These effects cannot be explained by differences in the style participants came up with their own estimations (i.e., RT until an estimation was made; Experiment 1 & 2), sampling errors (Experiments 2, 3 & 6), the stimulus material (Experiment 3), or task-difficulty of the visuo-spatial perspective-taking task (Experiments 4 & 5). Furthermore, this enhancement of the anchoring effect was systematic. Participants did not randomly provide higher or lower estimations but instead provided estimations closer to those of the person (Experiments 1-6). This, however, was only nominally true in Experiments 3, 4, and 6. Nonetheless, these experiments convincingly demonstrate that the assumption of a visuo-spatial point of view also translates to a stronger assumption of psychological states.

The second hypothesis was non-systematically investigated across all studies, and directly tested in Experiment 5. The results of this experiment confirmed that participants changed their thoughts only after they engaged in embodied self-rotation. That is, the anchoring effect was enhanced starting at 80° of angular disparity and at the same time the differences between participants' judgments and target judgments decreased starting at this level of angular disparity. Furthermore, there were no significant differences between any two levels of angular disparity either above or below this threshold and a general linear model did not fit the data of Experiment 5. This supports the notion that embodied self-rotation happens in an all-or-none fashion starting between 60° and 90° of angular disparity.

The final hypothesis could be partially confirmed as well in Experiment 6. This experiment showed that the effects observed on the personalized anchoring paradigm are related to ratings of perceived similarity. In particular, the degree to which participants adopted the specific thought of the target person (i.e., the difference between participant and target judgment) correlated with perceived similarity ratings. A mediation analysis showed that perceived similarity mediated the effect of perspective-taking on participants' judgments. However, within a full mediation model this interaction term was non-significant, likely because of an independent main effect of perceived similarity which was higher at 40° of angular disparity than at 160°. This could reflect an independently operating experiential process due to stimulus differences. Although future studies are needed to further investigate the relation between visuo-spatial perspective-taking and self-other merging, the correlation of the two measures constitutes a promising first step towards the construct validity of the personalized anchoring paradigm as a measure of psychological perspective-taking.

Therefore, overall the results strongly support the proposed process-based framework of perspective-taking and the idea that all kinds of perspective-taking (according to classic definitions of the construct) involve the same simulation of an embodied transformation of the self into another's position. However, this unitary view also needs further empirical validation using different dependent variables and also more direct evidence for a relation between conceptual and embodied self-other merging.

General Discussion

This thesis offers some important and interesting insights for researchers interested in perspective-taking, empathy, and theory of mind. At the same time, however, it has some noteworthy limitations that should be addressed in future research.

Limitations of the Present Research

Although methodological rigor was a high priority (all manipulations have been implemented orthogonally, many potential confounding variables have been ruled out in Experiments 2 to 4, the dependent measure was either adopted from previous high-quality publications (Mussweiler & Strack, 1999a, 1999b; Strack & Mussweiler, 1997) or thoroughly pre-tested in the case of Experiment 5, all studies had elaborate instructions to ensure that participants complete the tasks in the anticipated manner, and feedback was provided when they failed to do so, see Appendix D), the biggest methodological weakness was participants' non-compliance with the instructions of the egocentric task in Experiment 3. As already discussed there, participants seemingly had a hard time with egocentrically describing which hand they themselves would use to grab an object that lies in front of another social agent. Rather, participants automatically adopted the allocentric perspective of that agent which is in line with some prior research (see, e.g., Böckler & Zwickel, 2013; Samson et al., 2010; Santiesteban, Catmur, Hopkins, Bird, & Heyes, 2014; Schurz et al., 2015; B. Tversky & Hard, 2009). Only about one third of the participants in the egocentric condition of this study managed to complete the task appropriately. Obviously future research should seek to increase this number considerably. It remains unclear, however, how one should go about this without altering the visuo-spatial perspective-paradigm altogether.

One possible suggestion is to implement a training phase before the actual experiment which only stops when participants answer all trials correctly. But becuase this would also train participants on the task in general, it would affect its task difficulty. Since this training phase on average likely would have to be longer for the egocentric task, difficulty would not be homogenously affected in the egocentric and the allocentric task. Per se this is not a problem since Experiment 4 showed that task difficulty does not crucially affect the effects of visuo-spatial perspective-taking. However, excessive training of participants could lead participants to develop alternative strategies to solve the task. If it is very hard for participants to inhibit an allocentric perspective, they could recode the task and rather use strategies that do not involve a discrepancy between two visuo-spatial frames of reference. Therefore, a negative result in a control experiment with training prior to an egocentric task would not be ultimately convincing.

Another possibility is to identify moderators explaining why some participants are able to comply with the egocentric instructions whereas others fail to do so. If one were to identify a construct which differentiates between compliers and non-compliers, one could manipulate it to ensure compliance with the task or specifically recruit participants who are able to comply with it (although this would of course lead to a selection bias within the sample). Based on the existing literature it is plausible that very non-empathic people are able to inhibit foreign perspectives the best (Brunyé et al., 2012; Erle & Topolinski, 2015; Kessler & Wang, 2012).

This possibility could in fact also explain another problematic aspect of the results of Experiment 3. Remember that the egocentric condition in this experiment did not only show a null-effect (i.e., no enhancement of the anchoring effect at 160° of angular disparity) but rather an inversed pattern (i.e., the anchoring effect was larger at 40° of angular disparity). This effect would specifically be predicted for the most non-empathic or egocentric people. For this subsample, 160° of angular disparity trials could make the difference between two frames of reference more salient and hence make the importance of the egocentric frame of reference more salient as well. Therefore, the anchoring effect should be smaller at 160° of angular disparity because participants ignore the allocentrically provided numerical anchors to a higher degree (i.e., provide estimations which are further away from these anchors) – both of which was indeed the case in Experiment 3.

A similar reversal was found in Experiment 4, too, where the anchoring effect was enhanced at 40° of angular disparity in the non-social task. There, however, it cannot be as easily arranged with the concept of egocentrism. The results of Experiment 4 allow for the conclusion that the normal anchoring effect could indeed be subject to task difficulty whereas the personalized anchoring effect is not. More importantly, the alleged effect of task difficulty in this experiment runs counter to the effects observed across all experiments of the present thesis. Therefore even if it were true that task difficulty affects anchoring judgments, its effect would be in the opposite direction of the presently observed effects which thereby disqualifies it as an alternative explanation. Nonetheless future research could also think about other ways of enhancing task difficulty. For instance, an additional cognitive load manipulation could be implemented during the visuo-spatial perspective-taking paradigm. In this case researchers must ensure, however, that the manipulation does not interfere with the personalized anchoring paradigm. For instance, remembering an eight digit number or doing mental arithmetic during the task (cf., e.g., Kirchner, 1958) could function as a numerical anchor of its own.

Finally, two aspects of the data of Experiment 6 are problematic. First, perceived similarity was higher at 40° of angular disparity. Although this feeling of similarity was independent of participants' anchoring judgments, future research should implement a stimulus-matched paradigm with an additional assessment of perceived similarity to the target. As mentioned above, however, this is not a small feat given the fact that many participants engage in spontaneous allocentric perspective-taking even when instructed not to do so. Fortunately, since increased perceived similarity was independent of the anchoring judgments which are more closely tied to a simulative perspective-taking process, this main effect is rather inconsequential for the conclusions drawn based on Experiment 6 and could even be used as an example of the parallel operation of an experiential process that independently of perspective-taking leads to an empathic outcome. This further underlines the importance of process-based analyses of empathy and related phenomena.

Secondly, the difference between the zero-order correlations of perceived similarity and the anchoring differences in Experiment 6 was not significant between 40° and 160° of angular disparity. As mentioned previously, perceived similarity was enhanced for the 40° trials. Although the source of this increase was independent of the perspective-taking process, perceived similarity in general still should correlate with judgmental similarity albeit to a much lower degree. In line with this reasoning there was indeed a non-significant negative correlation also for 40° of angular disparity. Coupled with the small sample size of Experiment 6, this made it difficult to find a significant interaction. The mediation analyses further underlines the idea of two processes operating in parallel because individually the effect of perspective-taking on anchoring differences was mediated by perceived similarity. Only when the main effect of perceived similarity is entered into the model as an additional source of systematic variance, this mediation vanished. Note that both on methodological and on theoretical grounds (i.e., based on the presently proposed framework) a mediation analysis without a separate main effect of perceived similarity is tenable (cf. Hayes, 2009; Tabachnick & Fidell, 2007; Zhao et al., 2010). Nonetheless, future research should replicate Experiment 6 either with a larger sample or with a stimulus-matched visuo-spatial perspective-taking paradigm that would eliminate the main effect of perceived similarity between different levels of angular disparity.

Irrespective of these limitations the present thesis offers many interesting avenues for future research – both basic and applied – which will be discussed next.

Implications for Research on Perspective-taking

The immediate implication of the presented experiments is that manipulations of visual perspectives can influence the psychological state of a person as well, which is in line with a unitary view of perspective-taking. Furthermore, for the first time the results are actually conclusive with regards to the question which conception of perspective-taking likely is true whereas prior research in support of either view failed to provide such convincing evidence.

A unitary view contends that all kinds of perspective-taking are related because they share one central functional or procedural property. For perspective-taking this is the human capacity to overcome one's egocentrism (see, e.g., Ford, 1979). What sets the different kinds of perspective-taking apart is merely the content on which this shared process operates. In contrast, a segregated view holds that different kinds of perspective-taking can be differentiated on a process level as well. One example of such a view is the recent framework of "visual perspective-taking in mental imagery" (Libby & Eibach, 2011b) which states that although visual and psychological perspective-taking often lead to similar outcomes, their underlying cognitive architecture is fundamentally different.

In the introduction, three preconditions for the declaration of such views were specified. These were, first, a non-confounded manipulation of one kind of perspective-taking that is, second, connected with a measure specific to another kind of perspective-taking by, third, means of a shared mechanism. All of these criteria are clearly fulfilled by the present experimental setup: the selected visuo-spatial perspective-taking paradigm (Kessler & Rutherford, 2010; Kessler & Thomson, 2010; Surtees et al., 2013a, 2013b) clearly only involves perceptual perspective-taking. The personalized anchoring paradigm (cf. Mussweiler & Strack, 1999a; Mussweiler & Strack, 1999b; Strack & Mussweiler, 1997), on the other hand, clearly does not involve any perceptual, but purely psychological aspects. Finally, this thesis offers a mechanism which is shared between different kinds of perspective-taking, that is, an embodied simulation of a rotation of the self into another person's physical location (Kessler & Rutherford, 2010; Kessler & Thomson, 2010; Surtees et al., 2013a, 2013b). Note how close this mechanism comes to the idea of conceptual self-other merging (Aron et al., 1992) which is seen as the central outcome of the psychological perspective-taking process (Batson, Early, et al., 1997; Davis et al., 1996, 2004; Galinsky et al., 2005). Transposing your body in space until it matches that of another person is a very literal form of self-other merging which might ground the conceptual kind observed in psychological perspective-taking research. The fact that this connection has not been drawn by researchers in the field shows that segregated views of perspective-taking do not only seem to be wrong, but rather also detrimental to the advancement of this field of research because these views likely reduced communication between psychological and perceptual perspective-taking researchers.

Implications for psychological perspective-taking research. The present thesis offers a methodological innovation to social psychological perspective-taking research. In contrast to the strongly demanding instruction manipulations, the visuo-spatial induction used in the present experiments is completely demand-free.

In contrast, it is possible that in instruction studies many participants merely provide a socially desirable solution in response to the classically implemented vignettes or that they simply indicate their understanding of the story and that they are able to come up with an appropriate emotional response. This response, of course, in these cases would be independent of personal experience and therefore not an instance of perspective-taking according to central definitions of the construct (Batson, 2009; Davis, 1994). Furthermore, whereas instructions can induce any number of different processes such as the abovementioned non-empathic processes, theoretical reasoning about the target (a noetic process), experiential resonance (an experiential process), or full-blown perspective-taking (a simulative process), the options to solve the visuo-spatial task are limited, especially in socially skilled or empathic people (Brunyé et al., 2012; Erle & Topolinski, 2015; Kessler & Wang, 2012). It would be a promising endeavor to replicate classic psychological perspective-taking studies with this manipulation to further support a process-based view of the construct.

Based on the literature review parallel results would be expected primarily for studies that used the imagine-self instructions because these instructions also induce a simulative process. Again, it is almost trivial that an instruction to “put yourself in another person’s place” leads to simulations of a different visuo-spatial perspective and an embodied simulation of actually putting oneself into another person’s place as well.

For studies using the imagine-other instructions, however, parallel effects cannot be expected in all cases. For instance, when we are presented with a person at a funeral and instructed to "think about how the target person feels" (a noetic process), we likely would indicate that the person feels sad and in this case true simulative perspective-taking would also lead to feelings of sadness. The motivation to help that person, on the other hand, should be differentially affected by noetic and simulative processes. Whereas noetic reasoning makes prosocial altruism more likely, simulative perspective-taking does not. Creating a second-hand experience of extreme sadness likely rather is detrimental to altruistic helping because of the emotion's low intrinsic arousal (Russel, 2003). Such well documented dissociations between the two instruction manipulations (Batson et al., 1989; Batson et al., 1991; Batson et al., 1987; Lamm et al., 2007; Stotland, 1969; Vorauer & Sasaki, 2014), could be replicated using this novel manipulation to further corroborate a unitary view of perspective-taking by demonstrating convergent validity (towards other simulative inductions) and discriminant validity (towards noetic alternative processes) at the same time.

One final advantage of the visuo-spatial perspective-taking induction is that it can be delivered on a trial by trial basis independent of any context whereas classic instruction studies are bound to providing a specific person within a specific situation. Therefore this paradigm is much more feasible to investigate the basic social-cognitive architecture of perspective-taking independently of interindividual differences of the target person and the participant that affect the results of classic perspective-taking instruction studies.

Implications for perceptual perspective-taking research. Not only social but also cognitive psychologists interested in perceptual perspective-taking can benefit from the results of this thesis. The research landscape in this area is diametrically different from psychological perspective-taking: whereas research in the latter area neglected underlying mechanisms in favor of demonstrations of social-cognitive outcomes of perspective-taking, the opposite is true for perceptual perspective-taking. This research area did well to establish embodied self-rotation as the main underlying mechanism of the process but only rarely did these researchers consider that an embodied simulation might have further psychological consequences, too. In social psychology, of course, this is a well-known fact (for reviews, see, e.g., Körner et al., 2015; Meier et al., 2012; Niedenthal, Barsalou, Ric, et al., 2005; Niedenthal, Barsalou, Winkielman, et al., 2005; Niedenthal et al., 2009; T. W. Schubert & Semin, 2009).

This thesis is only a first step towards establishing the psychological consequences of perceptual perspective-taking. The presently used anchoring paradigm was chosen to be as cognitive and unemotional as possible because in this setup the relation between different kinds of perspective-taking was expected to be strongest. Future research could venture into combining the visuo-spatial induction of perspective-taking with more affective dependent measures which are typical in empathy research (see, e.g., Batson et al., 1989; Batson et al., 2002; Batson, Early, et al., 1997; Batson et al., 1987; Batson, Polycarpou, et al., 1997; Lamm et al., 2007; Stotland, 1969). Although the present framework is unitary in nature and assumes the same underlying process for all kinds of perspective-taking, it at the same time acknowledges that different contents might differentially instigate simulative, noetic, or experiential processes. It is for instance conceivable that strongly emotional setups reduce the impact of simulative perspective-taking because participants are unwilling to put themselves in a very distressing situation. This resistance to engage in simulative processes often is rooted in self-knowledge, that is, noetic processes. At the same time a highly emotional situation can invoke intrusive experiential processes, for instance, when we cry together with a friend who suffered a misfortune. While it should be possible to find effects of visuo-spatial perspective-taking on more emotional measures, too, the magnitude of these effects is likely smaller.

Implications for Applied and Clinical Research

As well as these theoretical and conceptual contributions to basic research in perspective-taking, the present thesis also has some applied implications – especially in the area of clinical psychology. As mentioned in the introduction, several clinical populations suffering from deficient empathy or theory of mind, such as people within the autism spectrum (Conson et al., 2015; Hamilton et al., 2009; A. P. Jones et al., 2010; Pearson et al., 2014; Perner & Leekam, 2008; Zapf et al., 2015; Zwickel et al., 2011), psychopaths (M. J. Chandler, 1973; Decety, Chen, Harenski, & Kiehl, 2013; Dolan & Fullam, 2004; A. P. Jones et al., 2010; Mullins-Nelson et al., 2006) or schizophrenic/schizotypic patients (Frith & Corcoran, 1996; Langdon, Coltheart, & Ward, 2006; Langdon, Coltheart, Ward, & Catts, 2001; Schiffman et al., 2004; Thakkar & Park, 2010) exhibit marked deficits in visuo-spatial perspective-taking.

Both theory of mind and empathy have been described as social-cognitive skills which in some cases require a person to overcome his or her egocentrism in favor of an allocentric point of view. A unitary view of perspective-taking would hold that this competence is shared between all kinds of perspective-taking, be they cognitive (theory of mind), affective (empathy), or perceptual – and so should deficits in this competence be. The inability of these clinical populations to de-center (in a cognitive or affective sense) could potentially be improved by a purely visuo-spatial perspective-taking training. Such a training might also have some advantages over existing interventions. Trainings in empathic responding, for instance, have been shown to be effective in specific contexts but trainees usually fail to see past the learning scenario and to generalize what was learned to different situations (Poole & Sanson-Fisher, 1980). Furthermore, existing empathy trainings mainly target the affective part of empathy while the cognitive component remains unchanged (Pecukonis, 1990). A visuo-spatial training is free of contextualization and more directly trains the competence of de-centering. Of course it is an open empirical question whether such a training would indeed also benefit social interactions because as mentioned in the introduction, interpersonal outcomes, such as altruistic helping, or in the case of clinical populations a reduction in criminal offenses (in psychopaths) or more positive social interactions (in autistic people) are not directly linked to the procedural characteristics of perspective-taking (see Figure 1). It could thus be argued that training the procedural aspects of the larger construct does not translate into such distal outcomes. Nevertheless, if such a training were to show practically significant effects, it could be an invaluable tool for clinical and ambulant therapy. Such a paradigm could even be developed into a home-use application or program which patients can freely work with at their leisure.

Reflections on Unitary and Segregated Accounts of Other Processes

The novelty of the present thesis lies in selecting a singular process which is involved in many related research areas such as empathy and theory of mind. By focusing on the micro-level it was possible to pinpoint the underlying processes of perspective-taking as a shared pathway to these larger phenomena. Such specific questions have rarely been answered previously because researchers seem to be overwhelmed by the sheer vastness of the human faculty to understand other people. It is understandable that theories want to address macro-questions such as “What is empathy?”, rather than selectively investigating minor parts of the whole. However, by focusing on the macro-level the developed theories and taxonomies became increasingly imprecise and ill-fit to generate specific predictions for scientific research.

On the flipside, while this thesis provides some clarity within the subfield of perspective-taking, many higher-level questions have been insufficiently answered and their scope goes well beyond perspective-taking which is naught but a small cog in the machinery of social cognition. Is it possible to generate more powerful theories for other related processes, too? In case of both noetic and experiential processes, this is comparatively more difficult. But there are some general principles which differentiate them from their simulative counterparts.

Principles of noetic processes. Noetic processes share the fundamental feature that they rely on personal knowledge. This, however, is much less distinct than embodied simulations which play an important role across contexts (see, e.g., Barsalou, 1999; Körner et al., 2015).

A relevant distinction in this context is between online and offline cognition (see, e.g., Schilbach, 2014). This distinction has already been applied to embodied cognition specifically

(Myachykov et al., 2014) and was already discussed by ancient philosophers (Aristotle, 1995, pp. XXII-XXVIII, 185-187 & 272-273). While a simulation is a productive act, where a person produces an experience whenever a situation necessitates it, noetic processes are reproductive acts which draw on existing memory traces that have been shaped by (repeated) experience to come up with predictions about present and future events. While a simulation on the spot is completely situated (online) and determines the process as well as the content of the mental operation, a noetic deliberation only determines the content which is drawn from an offline store and not which process proper, that is, which specific rule is applied to it. Furthermore, the available knowledge structures differ immensely between people.

Based on this it seems difficult to find one common underlying principle for all of these processes apart from the fact that they re-produce concepts from memory whereas simulative processes produce experiences on the spot. Based on this alone, no unitary view of noetic reasoning can be formulated. A construct that at least describes boundary conditions for the occurrence of these processes are protocentric representations (Karniol, 1986, 1990, 1995, 2003; Karniol & Shomroni, 1999). These are rules that are applied in non-significant situations until a threshold of relevance is surpassed. Whenever a situation is deemed relevant enough, an exception to the rule is computed on the spot, which then is an online and productive act again.

Principles of experiential processes. As mentioned in the introduction, experiential processes encompass every process that automatically brings about an empathic outcome and thus range from mimicry to resonance to emotional contagion and other related phenomena. As acknowledged by Batson (2009), these processes are rather eclectic (involving four of his eight conceptions of empathy) – even more so than noetic processes. The umbrella term that comes to mind when thinking about experiential processes is automaticity (for reviews, see, e.g., Bargh, 1994, 2006). However, the fact that these processes operate unconsciously, efficiently, without intention, and that they are hard to control, is too unspecific as a definitional feature. Another diagnostic feature of these processes is that they are largely independent from memory.

Rather, they are immediate reactions on the spot. However, as in the case of automaticity, this also does not imply that all of these processes are interchangeable.

Based on these two features experiential processes can at least be narrowed down to everything that is neither noetic nor simulative. Noetic processes both rely on memory and happen intentionally. And although simulative processes also happen online, in contrast to the automatically appearing experiential processes, they involve willful deliberation. Still, it is hard to pinpoint one underlying mechanism of experiential processes and in contrast to the unitary view of perspective-taking, this research area best proceeds by investigating different processes as stand-alone concepts in a segregated manner, as it presently does.

Reflections on Causal Directions

This thesis investigated one causal direction, namely that visuo-spatial perspective-taking can instigate psychological perspective-taking. This is the obvious direction of causality to investigate first because visuo-spatial perspective-taking ontogenetically (Aichhorn, Perner, Kronbichler, Staffen, & Ladurner, 2006; Flavell, 1968, 2000; Flavell et al., 1981; Kessler & Thomson, 2010; Masangkay et al., 1974; Perner, 1991) and phylogenetically (Call & Tomasello, 2008; Hare et al., 2000, 2001; Tomasello et al., 1998, 2003, 2005) precedes psychological perspective-taking. However, based on a unitary view one would assume that psychological variables can also affect visuo-spatial perspective-taking performance. Dispositional correlations between the two kinds of perspective-taking further support this (see, e.g., Brunyé et al., 2012; Erle & Topolinski, 2015; Kessler & Wang, 2012). Testing this other causal path seems like another immediate and interesting avenue for future research.

For instance, instructing participants to imagine being one of the protagonists of the visuo-spatial perspective-taking task as in classic instruction experiments (see, e.g., Batson, Early, et al., 1997; Davis et al., 1996, 2004; Stotland, 1969) should create a psychological state of self-other merging between participant and target, which in turn should facilitate the embodied self-rotation into the target's visuo-spatial perspective. Consequently, faster RTs for the "similar" target would be anticipated. Ecologically even more valid, features of the target could be manipulated that make it appear as psychologically closer to the participant. For instance, the target of the perspective-taking task could be a foreigner or wear a sweatshirt of the participant's university to demarcate him as an out- or in-group member. In a similar vein, one could also provide evaluative information about the target. For instance, one could describe one of the targets in a visuo-spatial perspective-taking task as a bad person. It is imaginable that such a manipulation would increase the RT participants need to adopt the "bad person's" visual perspective, because participants might be unwilling or unable to feel like this person.

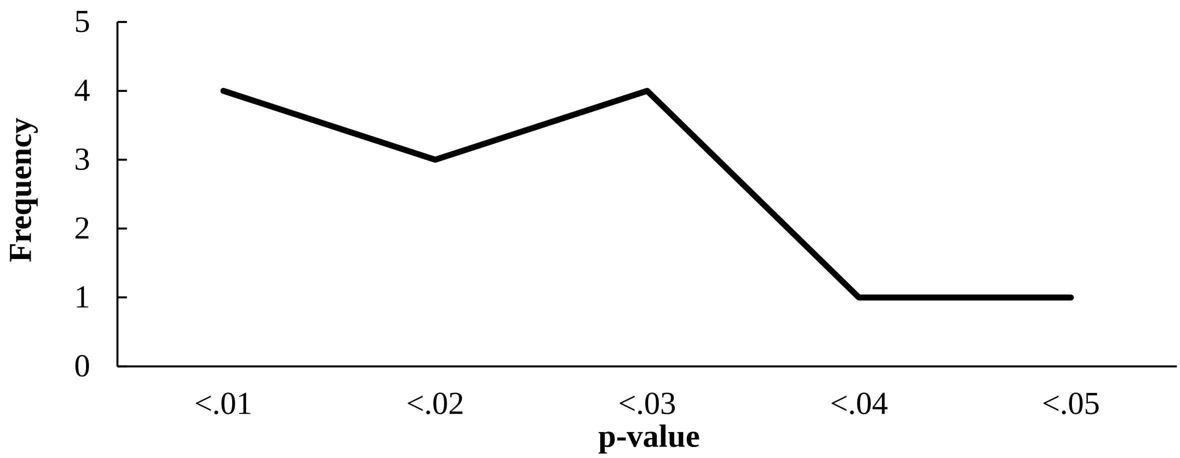
Reflections on Power and Replicability

Finally, a few thoughts on power and replicability seem warranted. Psychology recently fell into what could be called an identity crisis. Following reports of scientific misconduct that remained undiscovered for years, the field started to increasingly question the reliability of the findings it produces. Numerous papers reported a high prevalence of what is now called "questionable research practices" (John, Loewenstein, & Prelec, 2012; but see Fiedler & Schwarz, 2015) and documented in detail how these behaviors impact the replicability of psychological research (Simmons, Nelson, & Simonsohn, 2011) which ranges – depending on the criterion that defines a successful replication (for a sensible suggestion, cf. Simonsohn, 2015) – from very low to average at best (Klein et al., 2014; Open Science Collaboration, 2015). Regardless of how one approaches these issues ideologically, it seems prudent to evaluate conducted research not only in the light of its novelty but also with an emphasis on methodological rigor, statistical power, and evidential value of statistically significant findings.

A recently developed statistical tool to do this is the so-called "p-curve" (Simonsohn, Nelson, & Simmons, 2014; Simonsohn, Simmons, & Nelson, 2015). Based on the assumption that *p*-values are homogenously distributed under the null-hypothesis, this method simply tallies the number of *p*-values that are reported in a research paper. It is in principle possible that a researcher investigates a null-effect but repeatedly finds statistically significant findings, so-called “false-positives”. The *p*-value distribution of such false-positives obviously should also be homogenous below the specified alpha level. If instead of a null-effect a researcher looks at a “true-positive”, the distribution of the *p*-values is right-skewed.

Figure 27 shows the *p*-curve of the key results of the present thesis. Note that only significant *p*-values related to the central hypotheses of a study were included in this *p*-curve while non-significant results, manipulation checks, and trivial results such as an overall anchoring effect were excluded. Thereby the *p*-curve provides a very conservative estimate of the evidential value of the present results.

Figure 27. p-curve of the central results of this thesis.



Note. Based on 13 *p*-values. 5 non-significant findings are not displayed.

This analysis puts us in an interesting position because it is not compatible with any hypothesis tested by the *p*-curve analysis, see Table 1. The presented results neither contain evidential value, nor do they have inadequate evidential value, nor do they show evidence of intense *p*-hacking. Luckily, the *p*-value for the first hypothesis is by far the lowest, although statistically not significant, while the other hypotheses clearly cannot be arranged with the data.

Table 1. Inferential statistics of the *p*-curve analysis.

Statistical Inference	**Binomial Test**	**Continuous Test**
Studies contain evidential value.	*p* = .073	*p* = .088
Studies' evidential value is, if any, inadequate.	*p* = .725	*p* = .227
Studies exhibit evidence of intense p-hacking.	*p* = .981	*p* = .912

Notes. Based on 13 *p*-values. 5 non-significant findings are excluded from the analyses.

Secondly, a meta-analysis of the main findings as conducted. For this meta-analysis, only the difference between egocentric and allocentric anchoring effects and anchoring differences was analyzed and the control conditions of Experiments 3 and 4 were omitted. For all between-subjects designs (Experiments 1, 4, and 5), Cohen's *d* was calculated as:

$$d = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{(n_1 - 1) * SD_1^2 + (n_2 - 1) * SD_2^2}{n_1 + n_2 - 2}}}$$

For within-subjects designs (as in Experiments 2, 3, and 6), usually another metric, Cohen's d_z, is calculated which standardizes the mean difference by the standard deviation of the difference, rather than the pooled standard deviation (see above), see this formula:

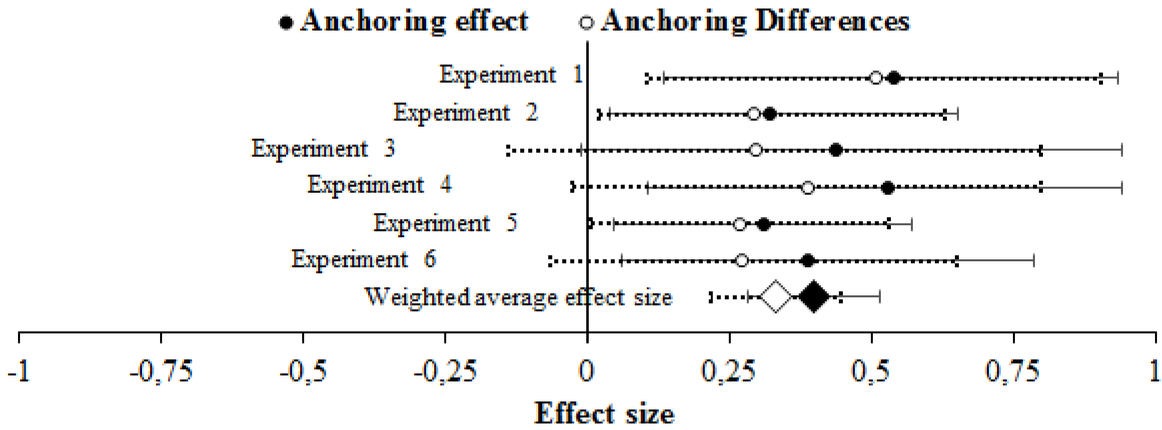
$$d_z = \frac{M_{difference}}{\sqrt{\frac{\sum\left(X_{difference} - M_{difference}\right)^2}{N - 1}}}$$

Following recommendations by Lakens (2013), instead of Cohen's d_z, Cohen's d_{av} was calculated in these cases. Whereas Cohen's d_z and Cohen's *d* cannot be compared directly, the metric of Cohen's d_{av} is rather similar to Cohen's *d* as it does not take the variability of the difference into account. Rather, Cohen's d_{av} standardizes by the averaged standard deviation of the two measurements, which makes it more similar to Cohen's *d*, see this formula:

$$d_{av} = \frac{M_{difference}}{\frac{(SD_1 + SD_2)}{2}}$$

Compared to the *p*-curve, this meta-analysis has the advantage that also non-significant results are included. Although some results are barely or even non-significant, meta-analytically the data clearly show a small to medium effect of visuo-spatial perspective-taking on the anchoring effect ($\bar{d}$= 0.40) and anchoring differences ($\bar{d}$= 0.33), see Figure 28.

Figure 28. Forest plot of the effect sizes of this thesis.



Note. Effect sizes for Experiment 1, 4, and 5 represent Cohen's *d*. Effect sizes for Experiment 2, 3, and 6 represent Cohen's d_{av}. Error bars show 95% confidence intervals.

What should be concluded based on these results? The presented data are certainly theoretically interesting, but from a purely statistical standpoint they seem suboptimal. The most obvious implication would be to conduct highly powered replication studies of these results. However, it is debatable how one should go about this. In this set of experiments, for instance, the sample size was varied considerably and this did not meaningfully affect the reported *p*-values. This shows that conducting only direct replications with larger *N*s is not a cure-all answer to methodological problems. Recent research has highlighted that increases in *N* do not necessarily increase the statistical power of an experiment when the number of stimuli used is not taken into account, too. Power increases as an asymptotic function when the number of stimuli is kept constant (Judd, Westfall, & Kenny, 2012; Westfall, Judd, & Kenny, 2015; Westfall, Kenny, & Judd, 2014). Therefore it might rather be prudent to increase the number of stimuli used in the anchoring paradigm, instead of increasing the number of participants.

Another detrimental effect on the effect size could be the fact that all experiments were carried out in Würzburg, using the same participant pool with a limited number of people in it. Recent research has shown that repeatedly testing the same participants can decrease effect sizes (J. Chandler, Paolacci, Peer, Mueller, & Ratliff, 2015). Repeated testing is further problematic because repeated exposure to the visuo-spatial perspective-taking paradigm could lead participants to develop non-simulative strategies which eliminate the embodied self-transformation. This might also have run counter to the attempt of increasing power via total *N*.

In addition to these methodological conundrums, the importance of conceptual replications cannot be stressed enough in this context. Albeit using suboptimal data to support its claims, this thesis is theoretically valuable for clarifying the many terminological confusions that exist in research on empathy, theory of mind, and psychological or perceptual perspective-taking. The measures used in this series of experiments were newly devised and therefore are limited in their generalizability. Instead of repeating the same experiment over and over again, it is also important to combine the newly acquired knowledge about the underlying processes of psychological perspective-taking to other measures of the construct. Showing that the embodied self-rotation can affect more than one measure of perspective-taking provides a theoretical argument for a unitary view of the construct, potentially the strongest argument, which has an epistemological value that can never be matched even by the most reliable direct replication. At the same time, of course, the reliability of findings is a precondition for this.

Therefore, while it is important to embrace new developments such as an increased focus on statistical power and replicability, theoretical underpinnings cannot take the backseat to this (for recent discussions, see, e.g, Fiedler, 2011; Strack, 2012). Rather than debating the evidential value of a set of studies or its credibility (Francis, 2013; Schimmack, 2012), one should question its theoretical conception and contribution. If a scientific paper is theoretically sound, it should be published. Methodological weaknesses, granted they do not question the overall validity of the theory, can still be ironed out after that. After all, we should not forget that scientific reports should inspire further research and not prevent it.

Concluding Thoughts

Let us close this thesis with another quotation by David Hockney that also comes from his biography: “In art, new ways of seeing mean new ways of feeling; you can't divorce the two, as, we are now aware, you cannot have time without space and space without time.” (Hockney, 1993, p. 165). We have learned that this is not only true for the arts but also for human social cognition. The way we look at a table with a book and a banana on it can affect what we think about the height of the cathedral of Cologne. In a very literal sense, in this case we cannot completely divorce the visual impression of a scene from a psychological judgment.

Hopefully this knowledge contributes to a renaissance of unitary views of perspective-taking in psychological research and makes us aware that the visual cannot be divorced from the psychological, just as we know that body and mind, as well as time and space are intimately intertwined. Psychological perspective-taking is grounded in visuo-spatial perspective-taking.

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Appendices

Appendix A: Trivia questions and corresponding numerical anchors

Question (*translation in italics*)	Low Anchor	High Anchor
Wie hoch ist das Brandenburger Tor? *How tall is the Brandenburg Gate?*	25	150
Wie breit ist der Kölner Dom? *How wide is the Cathedral of Cologne?*	60	320
Was ist die Durchschnittstemperatur im Winter in der Antarktis? *What is the average temperature during winter in the Antarctic?*	-20	-50
Was ist das Geburtsjahr von Leonardo Da Vinci? *What is the birth year of Leonardo Da Vinci?*	1391	1698
Wie hoch liegt Ulm über dem Meeresspiegel? *What is the elevation of Ulm above sea level?*	150	340
Wie lang ist die Elbe? *How long is the river Elbe?*	550	890
Wie groß (lang) ist ein Wal? *How long is a whale?*	21	49
Wann besuchte Albert Einstein zum ersten Mal die USA? *When did Albert Einstein first go to the USA?*	1921*	1939

Notes. All questions were succeeded by the sentence: “Diese Person schätzt: [anchor].” (“*This person estimates: [anchor]*”). *In some experiments, the low anchor for this question was changed to 1909.

Appendix B: Complete list of pre-test items for Experiment 5

Question (*translation in italics*)	*Md*	*15th %ile*	*85th %ile*
Wie lang ist die Autobahn A7 (in Km)? *How long is the Autobahn A7 (in kilometers)?*	700	400	1200
Wie viele Staaten gibt es in Afrika? *How many states are there in Africa?*	27	15	49
In welchem Jahr starb Ludwig van Beethoven? *When did Ludwig van Beethoven die?*	1810	1743	1879
Wie viele Studenten sind an der Sapienza Universität in Rom immatrikuliert? *How many students go to La Sapienza university in Rome?*	30000	3000	58000
Bei wieviel Grad Celsius liegt die Schmelztemperatur von Kerzenwachs (bei normalem Luftdruck, in °C)? *What is the melting point of candle wax (in °C, at normal atmospheric pressure)?*	65	39	100
In welchem Jahr wurde das TCP-IP Protokoll (Netzwerkprotokoll) eingeführt? *When was the TCP-IP protocol introduced?*	1994	1980	2001
Wie viele Berge über 8000 m gibt es auf der Erde? *How many mountains over 8000 meters exist on earth?*	7	4	23
Was ist die durchschnittliche Jahrestemperatur in Moskau (in °C)? *What is the average temperature in Moscow (in °C)?*	10	4	15
Wie hoch ist der Mount McKinley (in m)? *How tall is Mount McKinley (in meters)?*	5000	2000	7764
Wie lang ist der Nil (in Km)? *How long is the Nile river (in kilometers)?*	1300	314	6350
Wie viele Einwohner hat Los Angeles (in Millionen; also die Angabe "1" würde 1000000 Einwohner bedeuten)? *What is the population of Los Angeles (in millions; i.e., “1” would mean 1000000 people)?*	7*	4*	19*
Wie lange dauert ein Direktflug von Dubai nach Melbourne (in Stunden)? *How long is a direct flight from Dubai to Melbourne (in hours)?*	9	6	15
Wie groß ist die Oberfläche des Lake Huron in Kanada (in Quadratkilometern)? *What is the size of lake Huron in Canada (in square-kilometers)?*	200	20	5850
Wie viele Päpste gab es bisher in der katholischen Kirche? *How many popes did the catholic church elect until today?*	59	15	247
Wie teuer war das von Gerhard Richter gefertigte Domfenster in Köln (in Euro)? *What was the price of the Richter-window in the cathedral of Cologne (in Euro)?*	50000	4904	600000

Complete list of pre-test items for Experiment 5 (continued)

Question (*translation in italics*)	*Md*	*15th %ile*	*85th %ile*
Wie viele Wörter hat die deutsche Übersetzung der Bibel nach Martin Luther (diese Übersetzung umfasst das neue und das alte Testament)? *How many words does the German translation of the Bible after Martin Luther contain (this translation comprises the new and old testament)?*	*1000000*	*48079*	*22250000*
Wie viele einzelne Songs befinden sich insgesamt auf allen Originalveröffentlichungen der Beatles von 1958-1970? *How many Songs are on all Beatles albums released between 1958 and 1970?*	*120*	*50*	*336*
Auf welcher Höhe liegt die höchste Millionenstadt der Erde (in m über dem Meeresspiegel)? What is the altitude of the world's highest city with a population greater than one million people (in meters above sea level)?	*2000*	*500*	*4000*
Wie viele Autos baute Opel im vergangenen Jahr in Rüsselsheim? *How many cars did the Opel factory in Rüsselsheim produce last year?*	65000	5000	1000000
Wie viele Millionenstädte gibt es in Indien? *How many cities with a population over one million are there in India?*	10	2	14
Wie viele Präsidenten hatten die USA bisher? *How many presidents were elected in the USA until today?*	34	12	53
Wie hoch ist der Umsatz von Samsung pro Jahr (in Milliarden Euro; also die Angabe "1" würde 1000000000 Euro Jahresgewinn bedeuten)? *How high is Samsung's annual turnover (in billion Euros; i.e., "1" would mean 1000000000 Euros)?*	15**	4**	62**
Wie viele Kilokalorien (Kcal) enthält ein Glas Silvaner (0,25l) durchschnittlich? *How many kilocalories (Kcal) does one glass of Silvaner (0,25 liters) contain on average?*	188	82	350
Wie viele Straftaten werden durchschnittlich pro Jahr von der Würzburger Polizei bearbeitet? *How many crimes are processed on average by the Würzburg police department per year?*	1500	400	15000

Notes. *million people. **billion dollars.

Appendix C: Additional items and anchors for Experiment 5

Question (*translation in italics*)	Low Anchor	High Anchor
Wie lang ist die Autobahn A7? *How long is the Autobahn A7?*	400	1200
Wie viele Staaten gibt es in Afrika? *How many states are there in Africa?*	15	49
In welchem Jahr starb Ludwig van Beethoven? *When did Beethoven die?*	1743	1879
Wie viele Studenten sind an der Sapienza Universität in Rom immatrikuliert? *How many students go to La Sapienza university in Rome?*	3000	58000
Bei wieviel Grad Celsius liegt die Schmelztemperatur von Kerzenwachs bei normalem Luftdruck? *What is the melting point of candle wax in degrees Celsius at normal atmospheric pressure?*	39	100
In welchem Jahr wurde das TCP-IP Protokoll (Netzwerkprotokoll) eingeführt? *When was the TCP-IP protocol introduced?*	1980	2001
Wie viele Berge über 8000 m gibt es auf der Erde? *How many mountains over 8000 meters exist on earth?*	4	23
Was ist die durchschnittliche Jahrestemperatur in Moskau? *What is the average temperature in Moscow?*	4	15
Wie hoch ist der Mount McKinley? *How tall is Mount McKinley?*	2000	7764
Wie lang ist der Nil? *How long is the Nile river?*	314	6350
Wie viele Einwohner hat Los Angeles? *What is the population of Los Angeles?*	4*	19*
Wie lange dauert ein Direktflug von Dubai nach Melbourne? *How long is a direct flight from Dubai to Melbourne?*	6	15

Notes. The 15^{th} and 85^{th} percentiles were used as low and high numerical anchors in Experiment 5. All questions were succeeded by the sentence: “Diese Person schätzt: [anchor].” (“*This person estimates: [anchor]*”). *million people.

Appendix D: Instructions

Experiment 1, 2 & 5:

Instruction Screen #	Instruction
1	Nun folgt eine neuer Teil, während dem Sie immer zwei Aufgaben haben.
2	Sie sehen nun wiederholt einen Tisch mit einem Stuhl auf dem eine Person sitzt. Vor dem Stuhl liegen immer zwei Objekte - ein Buch und eine Banane.
3	In jedem Durchgang ist eines dieser beiden Objekte (Buch oder Banane) Ihr Ziel.
4	Ihre Aufgabe ist es, das Zielobjekt aus der Perspektive der Person zu "greifen". Sie verwenden dafür die beiden markierten STRG Tasten.
5	Liegt also beispielsweise das Zielobjekt von der abgebildeten Person aus gesehen links, drücken Sie die linke STRG Taste.
6	Bei dieser Aufgabe sind Schnelligkeit und Genauigkeit wichtig, strengen Sie sich also an, möglichst schnell die richtige Antwort zu geben! Wenn Sie einen Fehler machen, wird eine Fehlermeldung eingeblendet.
7	Anschließend wird Ihnen eine Allgemeinwissensfrage gestellt.
8	Zunächst wird Ihnen die abgegebene Schätzung der abgebildeten Person am Tisch angezeigt.
9	Danach erscheint ein Kästchen, in das Sie Ihre eigene Antwort auf die Frage eintragen.
10	Jeder Durchgang läuft wie folgt ab:
11	Zunächst wird Ihnen das Zielobjekt (Buch oder Banane) angezeigt. Wenn Sie es registriert haben, drücken Sie eine der beiden STRG Tasten.
12	Dann erscheint die Szene am Tisch und Sie sollen mit der rechten oder linken STRG Taste das Zielobjekt aus der Perspektive der abgebildeten Person "greifen", also erneut drücken.
13	Dann kommt die Allgemeinwissensfrage. Erst sehen Sie die abgegebene Schätzung der abgebildeten Person. Anschließend sollen Sie eine eigene Schätzung in ein Kästchen eintragen.
14	Wenn Sie keine Fragen mehr haben, geht es mit einem Klick auf "continue" los.

Experiment 3:

Instruction Screen #	Allocentric Task	Egocentric Task
1	Nun folgt ein neuer Teil, während dem Sie immer zwei Aufgaben haben.	Nun folgt ein neuer Teil, während dem Sie immer zwei Aufgaben haben.
2	Sie sehen nun wiederholt einen Tisch mit einem Stuhl auf dem eine Person sitzt. Vor dem Stuhl liegen immer zwei Objekte - ein Buch und eine Banane.	Sie sehen nun wiederholt einen Tisch mit einem Stuhl auf dem eine Person sitzt. Vor dem Stuhl liegen immer zwei Objekte - ein Buch und eine Banane.
3	In jedem Durchgang ist eines dieser beiden Objekte (Buch oder Banane) Ihr Ziel.	In jedem Durchgang ist eines dieser beiden Objekte (Buch oder Banane) Ihr Ziel.
4	Ihre Aufgabe ist es, das Zielobjekt aus der Perspektive der Person zu "greifen". Sie verwenden dafür die beiden markierten STRG Tasten.	Ihre Aufgabe ist es, das Zielobjekt aus Ihrer eigenen Perspektive zu "greifen". Sie verwenden dafür die beiden markierten STRG Tasten.
5	Liegt also beispielsweise das Zielobjekt von der abgebildeten Person aus gesehen links, drücken Sie die linke STRG Taste.	Liegt also beispielsweise das Zielobjekt von Ihnen aus gesehen links, drücken Sie die linke STRG Taste.
6	Bei dieser Aufgabe sind Schnelligkeit und Genauigkeit wichtig, strengen Sie sich also an, möglichst schnell die richtige Antwort zu geben!	Bei dieser Aufgabe sind Schnelligkeit und Genauigkeit wichtig, strengen Sie sich also an, möglichst schnell die richtige Antwort zu geben!
7	Anschließend wird Ihnen eine Allgemeinwissensfrage gestellt.	Anschließend wird Ihnen eine Allgemeinwissensfrage gestellt.
8	Zunächst wird Ihnen die abgegebene Schätzung der abgebildeten Person am Tisch angezeigt.	Zunächst wird Ihnen die abgegebene Schätzung der abgebildeten Person am Tisch angezeigt.
9	Danach erscheint ein Kästchen, in das Sie Ihre eigene Antwort auf die Frage eintragen.	Danach erscheint ein Kästchen, in das Sie Ihre eigene Antwort auf die Frage eintragen.
10	Wenn Sie keine Fragen mehr haben, geht es mit einem Klick auf "continue" los.	Wenn Sie keine Fragen mehr haben, geht es mit einem Klick auf "continue" los.

Experiment 4:

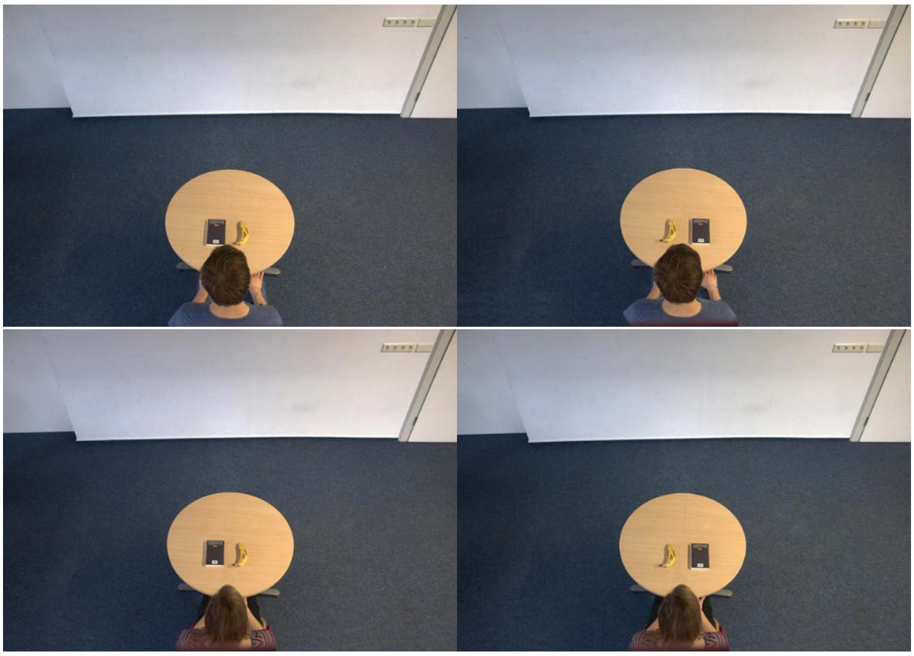
Instruction Screen #	Social Task	Non-social Task
1	Nun werden Sie immer zwei Aufgaben haben.	Nun werden Sie immer zwei Aufgaben haben.
2	Sie sehen nun wiederholt einen Tisch mit einem Stuhl auf dem eine Person sitzt. Vor dem Stuhl liegen immer zwei Objekte - ein Buch und eine Banane.	Sie sehen nun wiederholt einen Tisch mit einem Stuhl. Vor dem Stuhl liegen immer zwei Objekte - ein Buch und eine Banane.
3	In jedem Durchgang ist eines dieser beiden Objekte (Buch oder Banane) Ihr Ziel.	In jedem Durchgang ist eines dieser beiden Objekte (Buch oder Banane) Ihr Ziel.
4	Ihre Aufgabe ist es, das Zielobjekt aus der Perspektive der Person zu "greifen". Sie verwenden dafür die beiden GELB markierten Tasten.	Ihre Aufgabe ist es, das Zielobjekt aus der Perspektive des Stuhls zu "greifen". Sie verwenden dafür die beiden GELB markierten Tasten.
5	Liegt also beispielsweise das Zielobjekt von der abgebildeten Person aus gesehen links, drücken Sie die linke GELB markierte Taste.	Liegt also beispielsweise das Zielobjekt vom Stuhl aus gesehen links, drücken Sie die linke GELB markierte Taste.
6	Bei dieser Aufgabe sind Schnelligkeit und Genauigkeit wichtig, strengen Sie sich also an, möglichst schnell die richtige Antwort zu geben! Wenn Sie einen Fehler machen, wird eine Fehlermeldung eingeblendet.	Bei dieser Aufgabe sind Schnelligkeit und Genauigkeit wichtig, strengen Sie sich also an, möglichst schnell die richtige Antwort zu geben! Wenn Sie einen Fehler machen, wird eine Fehlermeldung eingeblendet.
7	Anschließend wird Ihnen eine Allgemeinwissensfrage gestellt.	Anschließend wird Ihnen eine Allgemeinwissensfrage gestellt.
8	Zunächst wird Ihnen die abgegebene Schätzung der abgebildeten Person am Tisch angezeigt.	Die Frage ist immer in einem entweder-oder Format gestellt (z.B. "Ist X größer oder kleiner als Y?"). Wenn Sie glauben, dass die zuerst genannte Option zutrifft (Beispiel: X ist größer), drücken Sie die linke markierte Taste. Wenn Sie der Meinung sind, die zweitgenannte Option trifft zu (Beispiel: X ist kleiner), drücken Sie die rechte markierte Taste.
9	Danach erscheint ein Kästchen, in das Sie Ihre eigene Antwort auf die Schätzfrage eintragen.	Danach erscheint ein Kästchen, in das Sie Ihre eigene Antwort auf die Schätzfrage eintragen.
10	Wenn Sie keine Fragen mehr haben, geht es mit einem Klick auf "continue" los.	Wenn Sie keine Fragen mehr haben, geht es mit einem Klick auf "continue" los.

Experiment 6:

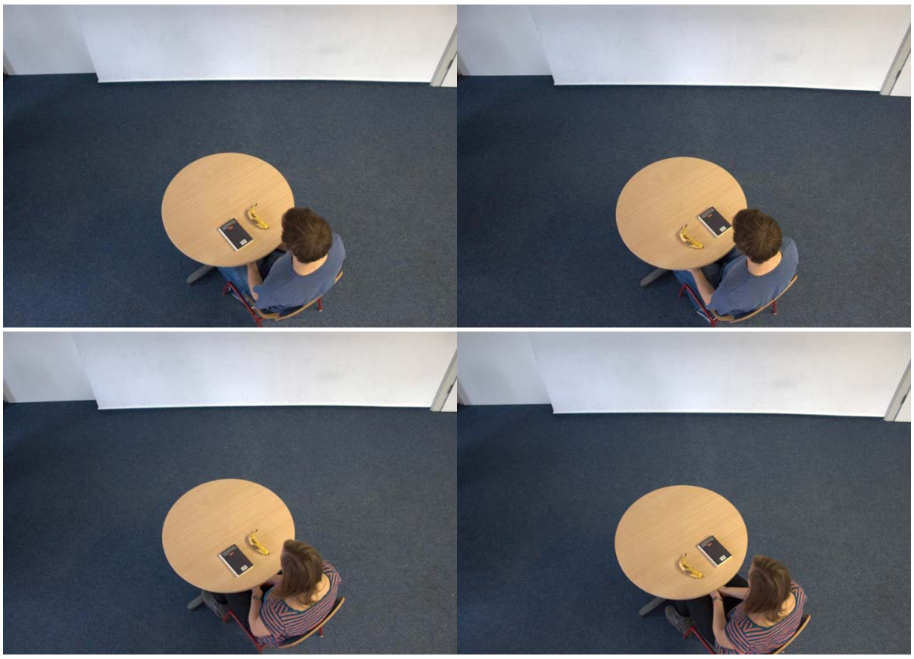
Instruction Screen #	Instruction
1	Nun folgt ein neuer Teil, während dem Sie immer drei Aufgaben haben.
2	Sie sehen nun wiederholt einen Tisch mit einem Stuhl auf dem eine Person sitzt. Vor dem Stuhl liegen immer zwei Objekte - ein Buch und eine Banane.
3	In jedem Durchgang ist eines dieser beiden Objekte (Buch oder Banane) Ihr Ziel.
4	Ihre Aufgabe ist es, das Zielobjekt aus der Perspektive der Person zu "greifen". Sie verwenden dafür die beiden markierten STRG Tasten.
5	Liegt also beispielsweise das Zielobjekt von der abgebildeten Person aus gesehen links, drücken Sie die linke STRG Taste.
6	Bei dieser Aufgabe sind Schnelligkeit und Genauigkeit wichtig, strengen Sie sich also an, möglichst schnell die richtige Antwort zu geben!
7	Nachdem Sie diese Aufgabe gelöst haben, wird Ihnen eine Frage zu der abgebildeten Person gestellt, die Sie mit den Nummerntasten 1-9 beantworten sollen. Hierbei gibt es keine richtigen und falschen Antworten und Sie müssen sich auch nicht beeilen.
8	Als dritte Aufgabe wird Ihnen eine Allgemeinwissensfrage gestellt.
9	Zunächst wird Ihnen die abgegebene Schätzung der abgebildeten Person am Tisch angezeigt.
10	Danach erscheint ein Kästchen, in das Sie Ihre eigene Antwort auf die Frage eintragen.
11	Wenn Sie keine Fragen mehr haben, geht es mit einem Klick auf "continue" los.

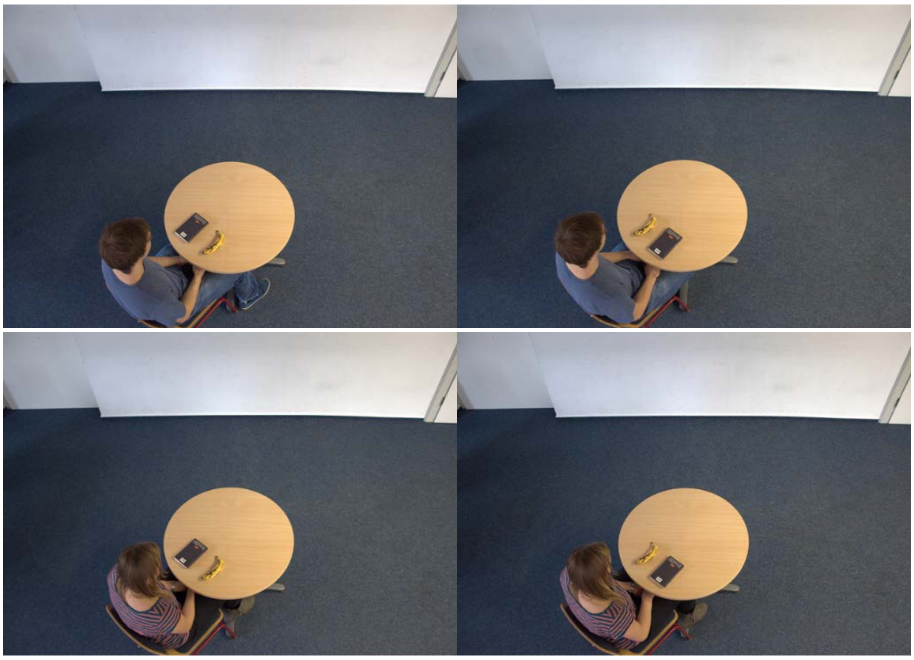
Appendix E: Stimuli of the Visuo-spatial Perspective-taking Task

0° of angular disparity (only presented in Experiment 5):

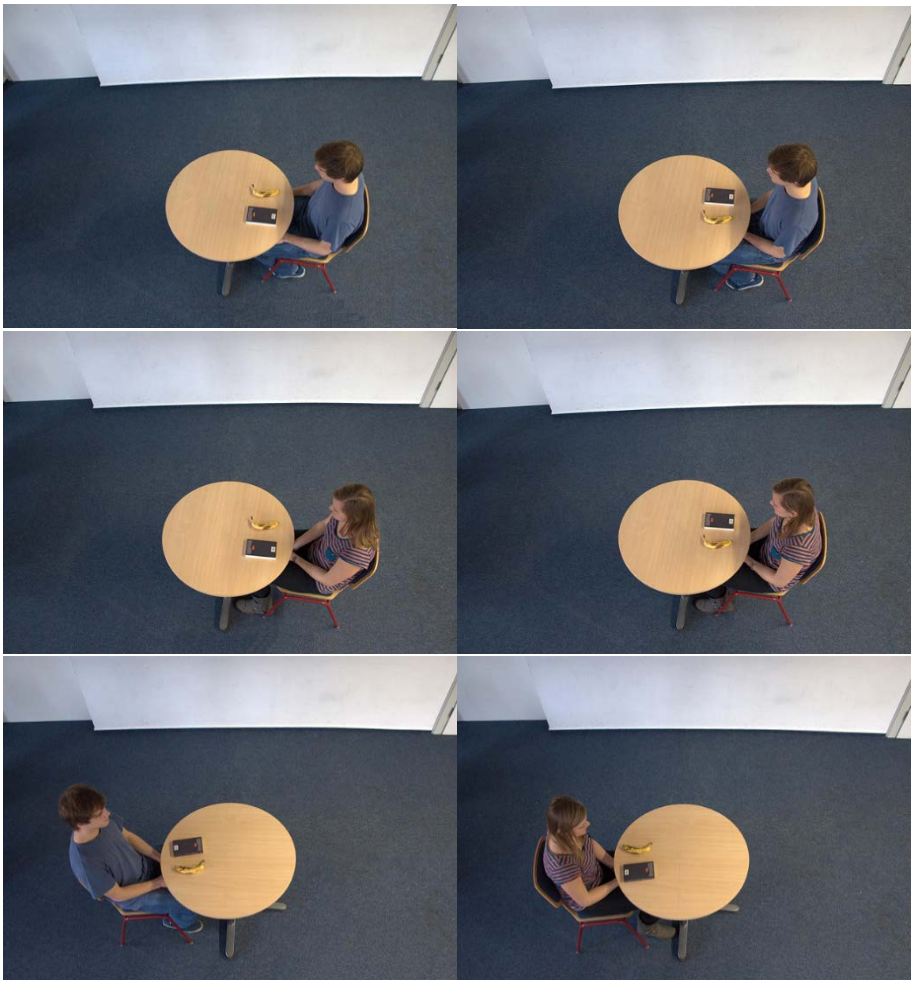


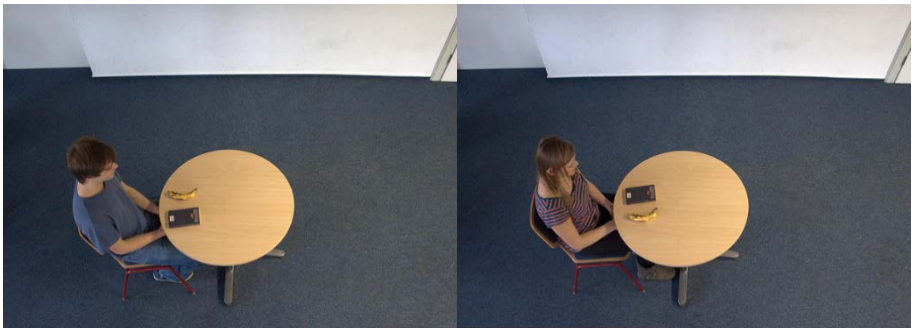
40° of angular disparity:



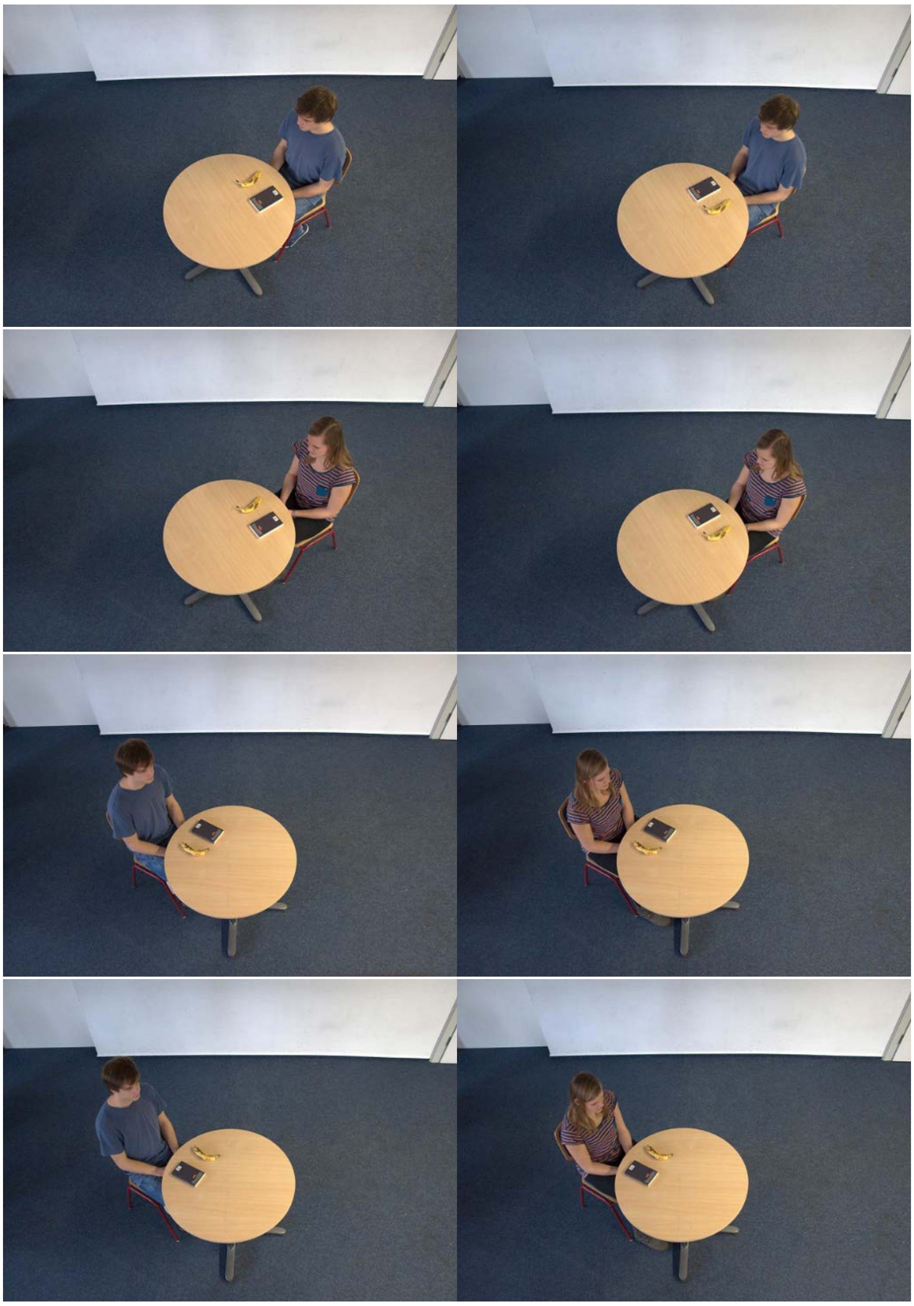


80° of angular disparity (only presented in Experiment 5):

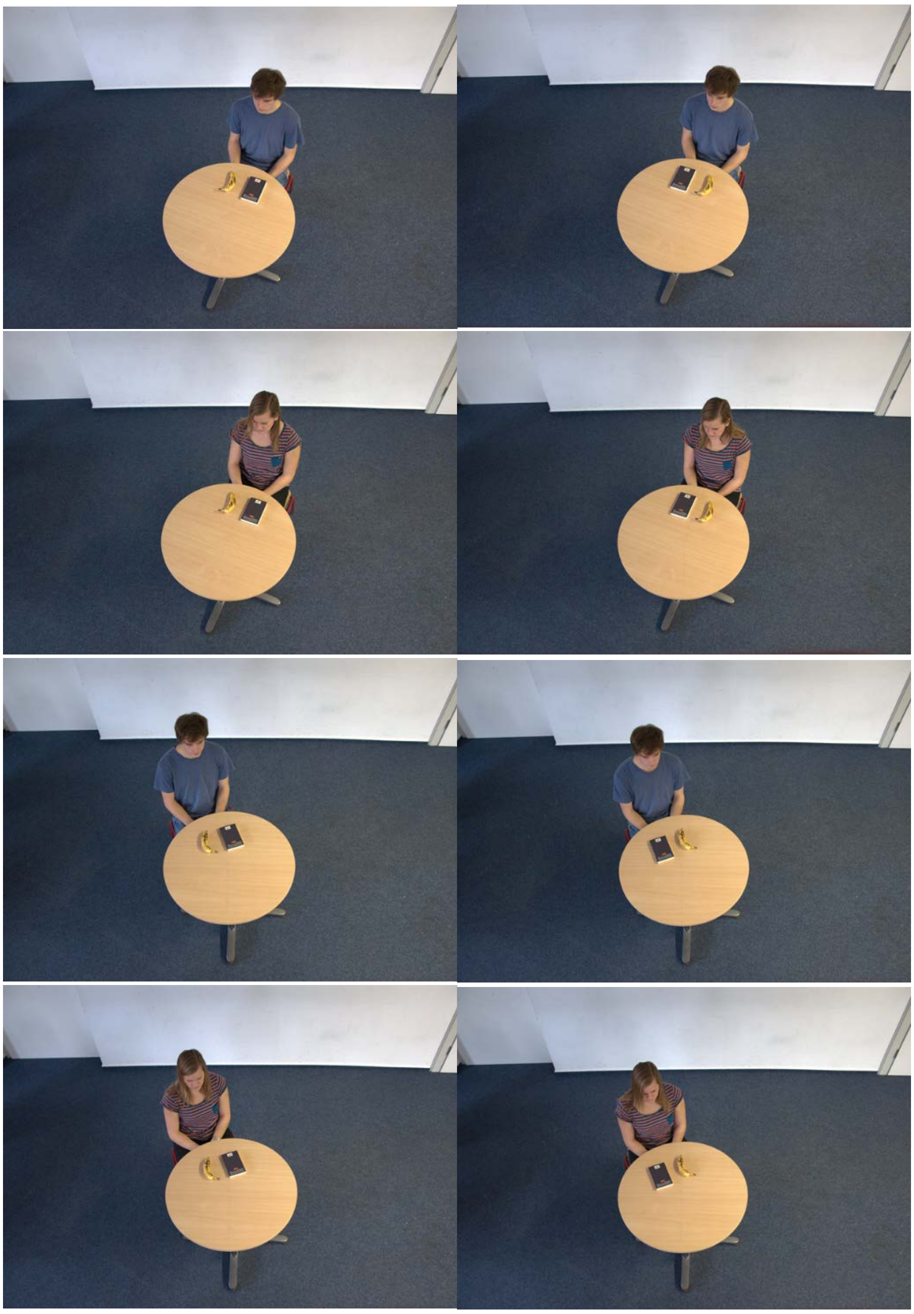




120° of angular disparity (only presented in Experiment 5):

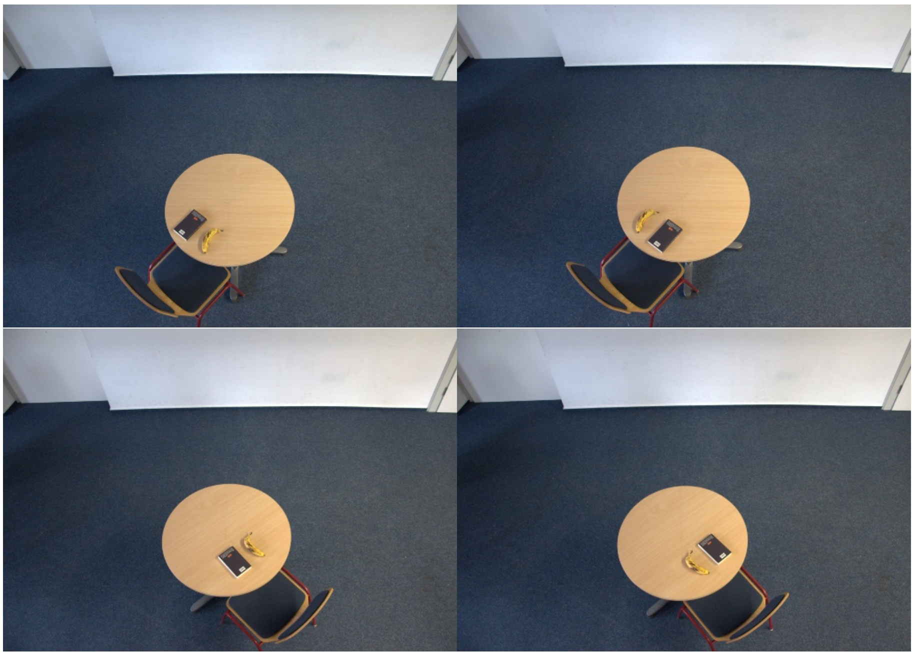


160° of angular disparity:

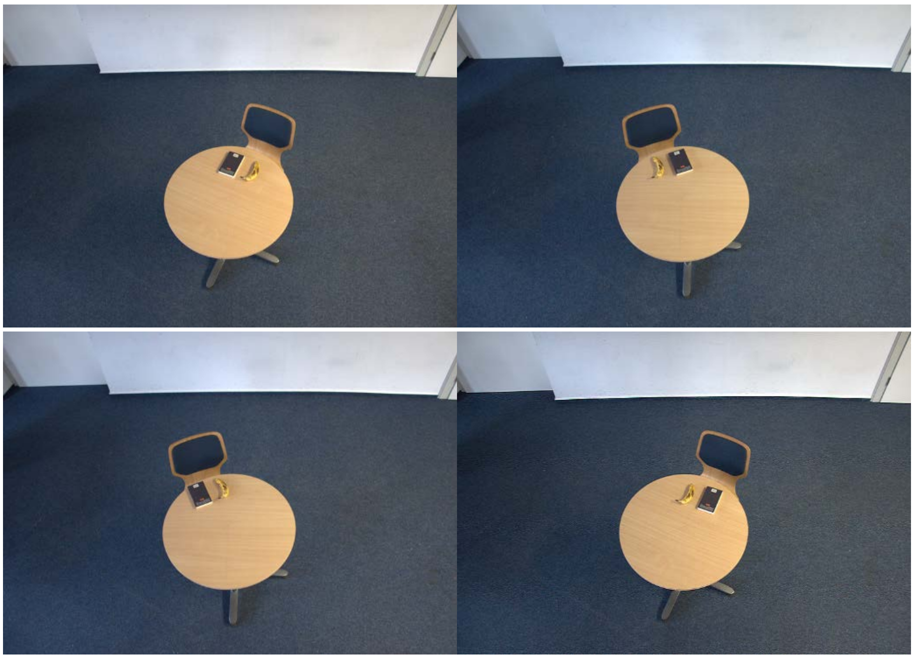


Appendix F: Stimuli of the Non-social Task (Experiment 4)

40° of angular disparity:



160° of angular disparity:



Appendix G: German Summary – Deutsche Zusammenfassung

„Perspektivenübernahme“ bezeichnet die Fähigkeit des Menschen, sich in die Lage eines anderen hineinzuversetzen (siehe, z.B., Davis, 1994; Ford, 1979; Kurdek, 1978; Mead, 1934; Piaget, 1932; Piaget & Inhelder, 1956; Underwood & Moore, 1982). In der psychologischen Forschung unterscheidet man drei Arten der Perspektivenübernahme, nämlich perzeptuelle, affektive und kognitive. Während man perzeptuelle Perspektivenübernahme im Wesentlichen als „perzeptuelle“ oder als „visuo-spatiale Perspektivenübernahme“ bezeichnet, ist die affektive Perspektivenübernahme auch stark mit dem Konzept „Empathie“ verwoben (Batson, 2009; Davis, 1994); und schließlich die kognitive Perspektivenübernahme mit dem Begriff „Theory of Mind“ (Premack & Woodruff, 1978). Diese beiden Arten der Perspektivenübernahme werden oft unter dem Sammelbegriff „psychologische Perspektivenübernahme“ zusammengefasst.

Diese Dissertation befasst sich mit der Frage, ob diese verschiedenen Arten der Perspektivenübernahme als theoretisch unterscheidbare Konstrukte oder lediglich als Facetten ein und desselben Konstrukts angesehen werden sollten.

Zugunsten eines einheitlichen Konstruktes könnte man die ähnlichen zugrunde liegenden Funktionen aller Arten von Perspektivenübernahme anführen: diese dienen dazu, den eigenen egozentrischen Standpunkt zu verlassen, um die Welt sprichwörtlich (im Falle affektiver und kognitiver) oder buchstäblich (im Falle perzeptueller) aus anderen Augen zu betrachten. Somit dient Perspektivenübernahme der Überbrückung der Differenz zweier kognitiver, affektiver oder visuo-spatialer Referenzrahmen. Gegen die Annahme eines einheitlichen Konstrukts spricht jedoch die Tatsache, dass es unterschiedliche und spezifische Messungstests für jeden der Subtypen gibt. Es stellt sich jedoch die Frage, ob eine Unterscheidung rein auf messtheoretischer Ebene auch konzeptuell stichhaltig ist.

Die Befundlage in der psychologischen Fachliteratur ist diesbezüglich nicht eindeutig. Während einige Autoren Korrelationen zwischen verschiedenen Arten der

Perspektivenübernahme für zu gering erachten, um ein einheitliches Konstrukt zu konstatieren (Ford, 1979; Gardner et al., 2012; Mohr et al., 2010), bewerten andere Autoren Korrelationen derselben Größe als Evidenz für solch ein einheitliches Konstrukt (Brunyé et al., 2012; Erle & Topolinski, 2015; Kessler & Wang, 2012). Ein weniger arbiträres Vorgehen wäre es, experimentalpsychologisch zugrunde liegende mentale Mechanismen zu identifizieren, die in alle Arten der Perspektivenübernahme involviert sind, und zu untersuchen, ob diese Mechanismen abhängige Maße affektiver, kognitiver und perzeptueller Perspektiveübernahme gleichermaßen beeinflussen.

Dieser Maßgabe folgend wird in der Einleitung die Fachliteratur zu den verschiedenen Arten der Perspektivenübernahme und verwandten Prozessen analysiert. Eine genaue Sichtung dieser größtenteils unabhängig forschenden Literaturfelder offenbart, dass in allen Gebieten ähnliche Prozesse und Unterscheidungen innerhalb verschiedener unabhängiger Taxonomien diskutiert werden. Ausgehend von der Empathie-Literatur (Batson, 2009; Davis, 1994) wird in der Einleitung dieser Arbeit eine einheitliche Taxonomie, die den Prozess der Perspektivenübernahme hinsichtlich seiner zeitlichen und prozeduralen Merkmale genauer definiert, erarbeitet, die drei Arten von Prozessen unterscheidet, nämlich experientielle, noetische und simulative Prozesse. Auch wenn alle diese Prozesse psychologische Zustände verursachen, die ebenfalls durch Perspektivenübernahme zustande kommen können, so entsprechen lediglich die simulativen Prozesse der basalen Definition von Perspektivenübernahme als der Fähigkeit, sich in die Lage eines anderen hineinzuversetzen und seinen Egozentrismus zu überwinden. Ausgehend hiervon wird vermutet, dass alle Prozesse, die einen solchen simulativen Prozess beinhalten, zu einem einheitlichen Konstrukt der Perspektivenübernahme zusammengefasst werden sollten. Alle experientiellen und noetischen Prozesse hingegen sollten hiervon ausgeschlossen werden, da sie vollkommen egozetrisch ablaufen. Diese Taxonomie wird in der Folge von der Empathieforschung auf alle anderen relevanten Forschungsfelder, die sich mit Perspektivenübernahme befassen, generalisiert.

Im Bereich der spatialen Kognition wurde in neueren Forschungsarbeiten die sogenannte „Level-2 Perspektivenübernahme“ (Flavell et al., 1981) als solch ein simulativer Prozess beschrieben. Diese Arbeiten zeigten, dass bei dieser Art von Perspektivenübernahme die perspektivenübernehmende Person mental eine Rotation des eigenes Körperschemas in die Position der Zielperson simuliert, was mental einen Zustand physikalischer Einheit schafft (vgl. Kessler & Thomson, 2010; Kessler & Rutherford, 2010; Surtees et al., 2013a, 2013b). Andere spatiale Kognitionen lassen sich anhand der erarbeiteten Taxonomie entweder als simulativ, aber egozentrisch, als experientiell oder als noetische Prozesse klassifizieren.

Studien im Bereich psychologischer Perspektivenübernahme hingegen fokussieren vor allem auf die psychologischen Konsequenzen einfacher Instruktionen, „sich in eine andere Person hineinzuversetzen“ (vgl., z.B., Batson, Early, et al., 1997; Davis et al., 1996, 2004; Galinsky, Wang & Ku, 2008; Stotland, 1969). Solche Instruktionen bewirken vor allem, dass sich die perspektivenübernehmende Person einem Ziel ähnlicher fühlt, was unter anderem zu mehr Sympathie (Batson, Polycarpou, et al., 1997), benevolenterem Verhalten (Batson et al., 2002) und zur Übernahme fremder Gedanken und Gefühle führt (Epley & Caruso, 2009; Epley et al., 2004). Obwohl sich anhand der Effekte verschiedener Instruktionen auch hier eine Unterteilung in experientielle, noetische und simulative Prozesse vornehmen lässt, ist es unklar, welche psychologischen Mechanismen durch solche Instruktionen in Gang gesetzt werden. Dies gilt auch für die simulativen Prozesse bei psychologischer Perspektivenübernahme.

Die vorliegende Dissertation versucht, diese unabhängigen Erkenntnisse im Rahmen des „Embodied Cognition“ Ansatzes (Barsalou, 1999) zu integrieren. Diese Theorie „verkörperter“ Kognition nimmt eine Wechselwirkung zwischen mentalen und physischen Zuständen an. Zahlreiche Arbeiten haben gezeigt, dass selbst abstrakte Konzepte eine verkörperte Entsprechung haben und sich über rein sensorische und motorische Aktivitäten oder selbst deren mentaler Simulation aktivieren lassen (für Übersichtsarbeiten, siehe z.B., Meier et al., 2012; Myachykov et al., 2014; T. W. Schubert & Semin, 2009).

Diesem Ansatz folgend macht die vorliegende Arbeit die Annahme, dass die mentale Selbstrotation des Körperschemas in die Position einer anderen Person, wie sie bei visuo-spatialer Perspektivenübernahme vorkommt, zunächst eine Simulation physikalischer Nähe ist. Diese Nähe ist im Sinne verkörperter Kognition ausreichend, um das Konzept psychologischer Nähe zu aktivieren, was wie bereits diskutiert der zentrale Mediator vieler Effekte von psychologischer Perspektivenübernahme ist. Somit fasst die vorliegende Dissertation Perspektivenübernahme als einheitliches und verkörpertes Konstrukt auf. Entgegen früherer Ansätze wird dies nicht nur über die zentrale gemeinsame Funktionalität aller Arten von Perspektivenübernahme, also dem Verlassen des egozentrischen Referenzrahmens zugunsten einer Fremdperspektive, gerechtfertigt, sondern außerdem mit der Annahme eines gemeinsamen zugrundeliegenden Mechanismus, nämlich einer verkörperten Simulation der Rotation des eigenen Körpers in die Position des Anderen, verbunden. Daraus wird die einfache Hypothese abgeleitet, dass visuo-spatiale Perspektivenübernahme zu psychologischen Konsequenzen führen kann.

Dies wurde in einer Reihe von 6 Experimenten getestet. In diesen Experimenten mussten die Probanden zunächst immer eine visuo-spatiale Perspektivenübernahme Aufgabe bearbeiten, in der es galt, die visuelle Perspektive einer anderen Person einzunehmen (vgl. Kessler & Thomson, 2010). In dieser Aufgabe sehen die Probanden eine Person, die mit zwei Objekten an einem Tisch sitzt. Die Probanden müssen in jedem Durchgang entscheiden, mit welcher Hand diese Person eines der beiden Objekte greifen würde. Dabei wird die Position der Zielperson manipuliert, so dass sie in der Hälfte der Fälle im selben visuo-spatialen Referenzrahmen wie der Proband sitzt, was Perspektivenübernahme zur Lösung der Aufgabe obsolet macht, während sie sich in den verbleibenden Durchgängen in einem anderen visuo-spatialen Referenzrahmen befindet, so dass die Probanden aktiv die Perspektive der Zielperson übernehmen müssen um die Aufgabe korrekt zu lösen. Somit kommt es in der Hälfte aller Versuchsdurchgänge zu visuo-spatialer Perspektivenübernahme und daher zu einer mentalen

Rotation des eigenen Körpers in die Position des Ziels, die ebenfalls empfundene Ähnlichkeit verursacht, während dies in den verbleibenden Durchgängen nicht der Fall ist.

Nach jedem Durchgang wurde dem Ziel dieser visuo-spatialen Aufgabe eine psychologische Eigenschaft zugeschrieben. Dies geschah im Rahmen eines abgewandelten Paradigmas zur Untersuchung der Ankerheuristik (vgl. Strack & Mussweiler, 1997). Hierzu wurde den Probanden nach jedem Durchgang der visuo-spatialen Aufgabe eine Schätzfrage gestellt. Zeitgleich wurde die Antwort des Ziels bekannt gegeben.

Entsprechend der Haupthypothese, dass visuo-spatiale Perspektivenübernahme psychologische Konsequenzen erzeugen kann, konnte gezeigt werden, dass die Probanden nach visuo-spatialer Perspektivenübernahme in höherem Maße die Gedanken der Zielperson übernahmen. Dies konnte sowohl anhand der absoluten Größe des Ankereffekts, als auch anhand der Differenz zwischen den Urteilen der Probanden und der Zielperson, gezeigt werden. Weitere Experimente schlossen Stichprobeneigenschaften (Experiment 2), die verwendeten Stimuli (Experiment 3) oder Aufgabenschwierigkeit (Experiment 4) als Alternativerklärungen für diese Effekte aus. SDie beiden letzten Experimente zeigten zudem, dass dieser Effekt spezifisch für alle Konstellationen ist, in den eine mentale Selbstrotation in die Zielperspektive notwendig ist (Experiment 5) und dass die Übernahme fremder Gedanken mit einem Gefühl von Ähnlichkeit assoziiert ist, die Effekte von visueller auf psychologische Perspektivenübernahme indirekt mediierten (Experiment 6).

Zusammengenommen unterstützen die Ergebnisse dieser Arbeit die theoretisch abgeleitete Sicht eines einheitlichen Perspektivenübernahme-Konstrukts und grenzen dieses zusätzlich von verwandten Konstrukten ab. In der abschließenden Diskussion wird die Bedeutung dieser Ergebnisse für die Forschung in den Bereichen Empathie, Theory of Mind, und Perspektivenübernahme und ebenfalls praktische Implikationen der Ergebnisse aufgezeigt. Darüber hinaus werden Limitation der durchgeführten Experimente sowie die Bedeutung der vorliegenden Arbeit für die Definition experientieller und noetischer Prozesse diskutiert.

Appendix H: Erklärung gemäß §4 Abs. 4 Nr. 3 der PromO vom 08.06.2001

Hiermit versichere ich an Eides statt, dass ich die Dissertation selbständig angefertigt und keine anderen als die angegebenen Quellen und Hilfsmittel benutzt habe.

Würzburg, den 07.01.2016, ______________________

Thorsten Michael Erle