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Using VR Technologies to Investigate the Flexibility of Human Self-Conception

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1. Introduction

This chapter will focus on the prospects of using virtual reality to study our pattern of use of the self-concept. A frequently discussed claim about the self-concept (or the first-person concept, as it is often called) is that when a subject employs it in thought, that thought is guaranteed to refer to the subject (Shoemaker 1968). But a less frequently discussed claim is that our thoughts about ourselves are nevertheless *flexible*, insofar as they involve a great deal of indeterminacy. That is, even if a subject is guaranteed to refer to herself when using the self-concept, she does not thereby ultimately determine what kind of thing she is.

To illustrate, suppose that Louis XIV once thought 'I am the State' and then around lunchtime thought 'I am hungry'.[1] If the celebrated referential guarantee of the concept expressed by 'I' obtains, then, in each use of the concept, Louis XIV would refer to himself. Yet he would refer to very different kinds of entity in each case. In the first case, he would (somewhat absurdly) be referring to himself *qua* the French government; in the second, he would (more plausibly) be referring to himself *qua* organism in need of sustenance. The claim that thoughts employing the self-concept are flexible implies that despite referring to very different kinds of thing, it might seem to Louis XIV that he refers to a single thing, namely himself. If true, this would be a highly peculiar feature. For in

Acknowledgements

This work was supported by a grant from the Volkswagen Foundation (Grant no. 89434: *Finding Perspective: Determining the embodiment of perspectival experience*) to AA and MRL. We would also like to thank an anonymous reviewer and the editors for insightful comments and suggestions.

[1] We take a little poetic licence here, as Louis XIV is actually credited with the statement 'L'état c'est moi' (the state is me) rather than 'Je suis l'état' (I am the state).

other cases in which multiple thoughts seem to refer to different kinds of entity, one might rightly judge that these thoughts do not all refer to a single thing. So, what is odd about our pattern of use of the self-concept, if it does exhibit such flexibility, is that it can seem to encompass reference to different kinds of entity whilst also seeming to refer to the very same thing in each case, namely oneself.

In the next section, we will clarify what exactly is meant by the claim that we will refer to as *flexibility*. The rest of the chapter will focus on assessing flexibility as an empirical claim, and, especially, the prospects of using virtual reality technology to investigate it. In Section 3, we will review virtual reality research that seems promising in this regard. In Section 4, we will raise certain key methodological issues with this research insofar as it might serve to demonstrate flexibility.

2. Flexibility and self-conception

2.1. Concepts and conceptions

To clarify the target of our discussion, we will operate with a distinction between concepts and conceptions. This distinction is commonly associated with Rawls' (1971) discussion of justice: Disagreement about justice is rife. But if that disagreement is genuine, it requires a common subject matter – the concept of justice – which the parties to the disagreement might apply very differently. These differences in application correspond to differences in conception, each of which may be wrong or partial with respect to the true reference of the concept. We distinguish, then, the concept of the self – whatever its true referent may be – from an individual's self-conception.

The distinction requires some way of cashing out the assumption that concepts have correctness conditions that are fixed independently of an individual's conceptions. For instance, an externalist theory of concepts might treat them as abstract objects, the correctness conditions for which are individuated independently of any given subject who might possess them (Putnam 1975). In a similar respect, an essentialist account of the psychology of concepts might hold that individuals believe that, for any member of a natural kind, there is an essence, the possession of which is necessary and sufficient for an entity to be a member of that kind (Keil 1989, Ch. 8). This essence would serve as an independent criterion according to which the accuracy of the individual's application of the concept (her conception) of that kind may be judged. For the purpose of our discussion, we will merely assume that there is some independent means of individuating concepts such that we can rightly distinguish them from conceptions. For those that do not embrace the distinction between concepts and conceptions, we ask only that they bear in mind that our discussion concerns how individuals apply a concept (and the underlying cognitive processes involved) not that to which the concept should be applied (and thus its correct reference).

Discerning an individual's self-conception is an empirical matter. One way of investigating it is to trace out the pattern of an individual's self-ascriptions, that is, ascriptions of properties and processes to herself in statements employing the self-concept, such as 'I am *x*', 'I am *y*-ing' and '*z* is mine'. This approach assumes that the statistics of linguistic usage are a guide to the structure of an individual's conception. Though the research we will review later can only be understood as revelatory of individuals' self-conceptions on this assumption, we do not mean to suggest that other approaches are invalid.

It is also worth distinguishing flexibility, as a feature of conceptions, from similar features of language, such as polysemy and metonymy. Consider, for instance, the sentence 'The White House got a new paint job' and the sentence 'The White House issued a press release'. In these two sentences, very different properties are attributed to the grammatical subject of each sentence because the noun phrase 'The White House' is polysemic: it can refer to a group of buildings or a group of people. However, if it seemed to someone that she were referring to the very same thing by 'The White House' when ascribing properties to a group of buildings and to a group of people, then her conception of 'The White House' would be flexible in this regard. The hypothesis we will consider is that individuals possess a self-conception that is flexible, such that an individual's self-ascriptions might encompass properties and processes attributable to various kinds of entity, whilst she nevertheless refers to a single entity – herself.

2.2. Self-conceptions and the concept of the self

Much philosophical discussion of self-consciousness involves responding to Cartesian claims about the concept of the self; in particular, the claims that the self is not a part of the objective world and that the self is indivisible.[2] These claims are inherently difficult to reconcile with the idea that selves can be identified with human bodies, as these are usually conceived to be objectively

[2] For exposition of these claims in Descartes' (1642/1984) 2nd and 6th meditations, as well as other writings, see Wilson (1978, Chs 2 and 6).

existing, divisible entities. This reflects a broader tension that constitutes one of the most ancient and enduring problems in the study of the mind, namely the reconciliation of our apparent mental and material natures.

One reaction to this tension is to attempt to find its roots in the contrast between two compelling *conceptions* of ourselves, as mental and material entities (cf. Papineau 2002; Bloom 2003).[3] What is compelling about the Cartesian conception of the self is the certainty of the *cogito* – the certainty with which one can infer 'I exist' from 'I am thinking', where the latter is grounded in an occurrent conscious mental event. Self-ascriptions of bodily properties are also compelling, especially when made on the basis of perceptual information concerning our bodies. Thus, we are disposed (on the basis of the right kinds of information) to make self-ascriptions such as 'I am hot and sweaty' and 'I am in front of a tree' (Evans 1982, Ch 7).

Evans concluded that because these bodily self-ascriptions exhibit the referential guarantee distinctive of the self-concept, they can serve as a 'powerful antidote to a Cartesian conception of the self' (Evans 1982, 220).[4] Leaving aside the issue of whether these cases do have such a guaranteed reference, it is clear that if an individual is disposed to make such bodily self-ascriptions, then she conceives of her body as herself. Evans' conclusion is then that the Cartesian theorist's conception of the self as potentially disembodied does not map onto our self-conception.

But it is not clear that this move is valid. Certainly, there is a manifest incoherence in the idea that we could be incorporeal minds and yet possess such properties as being hot and sweaty. And to claim that the Cartesian conception maps onto a *part* of our self-conception, would be to thereby render that conception as a whole potentially incoherent. But why should we assume that the question 'How do individuals conceive of themselves?' must return a metaphysically coherent answer?[5] Indeed, the distinction between concepts and conceptions is effectively a distinction between the metaphysical principles that hold true of a domain and an individual's capacity to apply concepts concerning

[3] Accordingly, flexibility might not be unique to our use of the self-concept, but a more general feature of our conception of entities to which we attribute psychological properties, such as persons (cf. Perry 1978), animals (Clark 2003) and even groups (List and Pettit 2011).

[4] Evans claim, it should be noted, is that these perceptually based self-ascriptions are immune to error through misidentification relative to the first-person pronoun. Here Evans is following the common practice of taking immunity to error of this kind as a guide to an account of self-consciousness. For a discussion of Evans strategy on these terms, see Brewer (1995, 291–297).

[5] This is characteristic of the descriptive approach to metaphysics, the aim of which in this case would be to lay bare the core components that any individual's self-conception must possess in order that she might have the capacities for thought the she does (cf. Strawson 1959/2003, especially Ch 3).

that domain. Thus, even if a metaphysical theory of the self may be in the business of determining the nature of the referent of the self-concept, individuals might not need to meet this standard to engage in self-ascription (Peacocke 2014, 140–141). As Campbell puts it, it might just be that 'our ordinary use and understanding of the first person leaves it open what kinds of things we are' (2004, 476). In short, it is not clear that our self-conception is so determinate that it cannot abide incoherence.

The notion of a *flexible* self-conception expresses the idea that indeterminacy in our self-conception can potentially yield incoherence. We suggest that flexibility can be more precisely stated in terms of two dimensions of higher-order difference/similarity between pairs of self-ascriptions. Dimension 1 concerns the degree of *difference* in the range of entities to which self-ascriptions are made. Thus, compare the following two pairs of thoughts:

Pair 1: "I am a physical body" and "I am a non-physical soul"
Pair 2: "I am a human" and "I am a cyborg"

One of the ways in which pairs 1 and 2 differ is that there is a greater difference between physical and non-physical entities than there is between humans and cyborgs. In the framework we propose, this amounts to greater flexibility in pair 1 than pair 2.

Dimension 2 concerns the degree of *similarity* in context between self-ascriptive thoughts. For instance, consider:

Pair 3: "I will die one day" and "I am immortal"

According to the framework we propose, when the thoughts in pair 3 occur in a single context, such as a Sunday sermon, they exhibit greater flexibility than when they each occur in different contexts, such as a biology class and a Sunday sermon.

We can illustrate a case of extreme flexibility by recalling a great conflict within Descartes' work. Whilst he famously conceived of the subject of thought as potentially disembodied, he also conceived of the subject of bodily sensations as united with the body as a whole (Wilson 1978, 181 ff.), apparently admitting this tension (in his correspondence with Princess Elizabeth of Bohemia) as follows:

> [It] does not seem to me that the human mind is capable of conceiving very distinctly, and at the same time, the distinction between the soul and the body and their union, since to do so it is necessary to conceive them as one single thing and at the same time to conceive them as two, which is contradictory. (Descartes 1643/2007, 70)

With a slight liberty of interpretation, we can translate Descartes' failure of imagination here into a claim to be stated in the framework we are suggesting: there cannot be a self-conception so flexible that the subject can, in the very same context, conceive of themselves as an indivisible and a divisible entity.[6]

It would be unwise to test the general claim of flexibility by focusing on an extreme case such as this. Flexibility in more moderate forms will consist of self-ascriptions in slightly different contexts, involving properties attributable to more similar, but nevertheless distinct entities. Of particular interest to us are self-ascriptions involving properties attributable to the human body and entities similar to the human body. Since the 19th century at least, theorists have suggested that humans' relationship to technology calls into question whether we ought to identify the bodily self with the human body, or the human body and some technological complement (see e.g. Lotze 1888, 587–90). A philosopher in the grip of metaphysical theory might insist that we identify the human bodily self with the human body. But this leaves open the question of whether such an assumption – or indeed general assumptions about determinacy – are in any way built into our self-conception, rather than merely built into contemporarily popular accounts of the reference of the self-concept (Martin 1997, 133–134).

If our self-conception is indeed flexible, then it ought to be possible to induce individuals to self-ascribe properties attributable to a range of distinct entities in somewhat similar contexts. Philosophers have, as we have seen, expressed a variety of intuitions on this subject, but this is clearly an issue that ought to be subject to systematic empirical research. The remainder of this chapter will focus on the question of whether and how empirical research using virtual reality technology might establish this, by inducing subjects to make self-ascriptions to not only their actual bodies but also distinct entities, such as virtual bodies.

3. Flexibility and VR

In this chapter, we operate with a fairly inclusive definition of virtual reality (VR) technology as ranging over a variety of sensor display and tracking technologies. Perhaps the most well-known technologies are *visual displays*, such as light-weight, head-mounted displays (HMDs), or ultra-high resolution,

[6] It is not clear that Descartes is right on this point: I might conceive of myself as divisible in the sense that, for example, a guillotine could conceivably 'divide' me into a head and torso. But I might also think that were that to happen, I would stop existing, and that I am therefore indivisible in this respect.

large-screen immersive displays (sometimes known as CAVE systems). Either of these can be combined with wireless motion-tracking to enable exploration of a virtual environment (a computer-generated simulation) or a video feed from another location in a real environment. Visual displays can also be combined with headphones to provide a realistic *acoustic* dimension to the environment, by implementing functions (known as head-related transfer functions) that characterize how the human head filters sound (Bergström et al. 2017, Berger et al. 2018). *Haptic* feedback can also be integrated with tracking and other displays to simulate physical encounters with objects in the environment by means of force-feedback devices, pressure devices, vibrotactile devices or even low frequency audio (Spanlang et al. 2014).

When correctly combined, these technologies have the capacity to enable subjects to feel 'present' in virtual worlds through synthetic sensory stimulation. At the heart of the phenomenon of feeling present in a virtual world is the experience of virtual embodiment, resulting from the use of a virtual body (known as an 'avatar') to regulate sensory and motor engagement with the environment (Slater 2009). In this section, we review recent work on virtual embodiment to show how it provides *prima facie* empirical support for flexibility.

3.1. Virtual embodiment

Contemporary research in VR aims not merely to simulate previous experiences of physical reality, but rather to provide fundamentally different forms of experience using the unique possibilities of the medium (Slater and Sanchez-Vives 2016). These unique possibilities depend upon inducing in users the feeling of being 'present', not in their actual environment, but in a virtual environment. As it is currently understood, presence is a twofold illusion, consisting of both a 'place illusion' – in which it seems to a subject that she is placed within a real scene – and a 'plausibility illusion' – in which it seems to a subject that she is participating in real events (Slater 2009). Recent work has demonstrated that users' 'embodiment' of a virtual character involved in unfolding events is not only essential to place illusions, it is also a powerful contributor to plausibility (Skarbez et al. 2017).

'Embodiment' is a notion that means many things to many people (Alsmith and de Vignemont 2012). In the VR literature, it is commonly used as an umbrella term that encompasses various ways in which information concerning an entity's properties is processed in a manner that is similar to information concerning an individual's actual body (cf. Kilteni et al. 2012). Accordingly, it is

a graded notion, with degrees of embodiment according to degrees of similarity in the relevant information processing (de Vignemont 2011, 88).

Paradigms for inducing and measuring embodiment were originally developed using physical props, especially rubber hands, and multisensory stimulation protocols. In a typical setup, such as the 'rubber hand illusion', a participant would observe a brush making physical contact with a rubber hand in a stroking motion, and their actual hand would also be stroked, whilst obscured from view (Botvinick and Cohen 1998). When the stroking motion participants saw on the rubber hand was kept in spatial congruence and temporal synchrony with the stroking motion they felt on the rubber hand, participants would exhibit a variety of behavioural and physiological responses that indicate their embodiment of the rubber hand. These include introspective reports about subjective experiences of body ownership (Longo et al. 2008), perceptual judgements of the location of their own hand as closer to the rubber hand after stimulation (Tsakiris and Haggard 2005); reduced temperature of the participant's own hand after stimulation (Moseley et al. 2008); increased electrodermal activity (Armel and Ramachandran 2003) and a distinctive cortical anxiety response (Ehrsson et al. 2007) when the observed hand is subjected to violence after stimulation.

In recent years, these paradigms have been adapted by researchers using VR technology to embody virtual objects. For instance, using motion-tracking of the head and a stereoscopic image projection system (similar to that used in 3D cinemas) researchers created a virtual analogue of the rubber hand illusion, the virtual arm illusion (Slater et al. 2008). On the display, participants would see a virtual arm that would appear (from the participant's perspective) to be extending out from the position of the shoulder of their right arm. Their right arm itself was hidden from view, extending in a slightly different direction from the virtual arm. A virtual ball, motion-tracked to an actuator wand held by the experimenter, was used to tap the virtual ball on the hand of the virtual arm, by tapping the wand on the participant's actual hand. Participants' responses indicated that they had embodied the virtual arm: After stimulation, the location of the hand of their actual (hidden) arm was judged to be closer to the hand of the virtual arm. Also, when the virtual arm was programmed to rotate slowly, electromyography revealed increased corresponding muscle activity in the participant's actual arm during the virtual arm's rotation.

Perhaps the majority of research on the embodiment of virtual objects studies users' embodiment of virtual avatars. Virtual avatars are (typically humanoid) virtual objects whose shape, position and movement are highly congruent with the shape, position and movement of the participant's actual body. In an early study, Lenggenhager et al. (2007) used a head-mounted display to present participants with a body projected two meters in front of their perspective in virtual space, which they observed being stroked on its back whilst they were stroked on their own back. Again, participants' behavioural responses indicated that they had embodied the virtual body: after stimulation, participants were moved backwards and asked to walk forwards to their original position, and they judged it to be closer to the position of the avatar.

Complex VR systems can involve a range of spatially and temporally integrated sensory displays and motion-tracking systems to simulate effectively the structure of perceptual engagement with a real environment (Cummings and Bailenson 2016). Embodiment of avatars is in part a function of the VR system's adherence to the spatiotemporal principles of multisensory integration between visual, auditory, tactile, proprioceptive and vestibular processes (Menzer et al. 2010; Ionta et al. 2011; Kilteni et al. 2015). Accordingly, avatars are often presented from a 'first-person' point of view, visually presenting the virtual body from a location and direction congruent with the view a participant would have of their real body (Petkova et al. 2011). Besides facilitating bottom-up multisensory processing, including a virtual avatar in the virtual scene in this way also serves to increase the adherence of the content to the users' expectations (Slater 2009; Gonzalez-Franco and Lanier 2017; Skarbez et al. 2017). In addition, virtual mirror exploration can serve to both enhance embodiment effects and provide further visual information about body part size and other characteristics (Gonzalez-Franco et al. 2010).

3.2. Virtual embodiment and self-ascription

Besides behavioural and physiological measures of embodiment, researchers have employed questionnaires to gain some sense of participants' experience of the objects they are induced to embody. This methodology also stems largely from the rubber hand paradigm. In their original study, Botvinick and Cohen (1998) presented their participants with a series of eight statements, to which they were asked to rate their agreement or disagreement on a seven-point scale (from-3 for strong disagreement, to +3 for strong agreement). One of these statements, 'I felt as if the rubber hand were my hand', intended to measure participants' sense of ownership for the rubber hand, was given an average rating of 2.5. Results such as these, together with reports of participants making statements like 'I found myself looking at the dummy hand thinking it was actually my own', served to establish the paradigm's relevance for experimentally

manipulating the experience of bodily ownership, that is, the experience of one's body as one's own (de Vignemont 2013).

In a large-scale study, Longo and colleagues (2008) used *principal components analysis* to investigate patterns of co-variation in responses to 27 statements about the participant's experience of the rubber hand illusion. Their results indicated that the experience of the illusion could be decomposed into distinct components. In particular, they distinguished three components: the sense of body ownership (in statements such as 'It seemed like the rubber hand was my hand'), self-location (in statements such as 'It seemed like my hand was in the location where the rubber hand was') and the sense of agency (in statements such as 'It seemed like I was in control of the rubber hand'). We will briefly illustrate how each of these components has been investigated in questionnaires concerning virtual objects.

3.2.1. Ownership

Body ownership is the typical subjective measure of participants' experience of virtual bodies and virtual body parts. Concerning the latter, Slater et al. (2008) presented participants with a questionnaire which included the statement, 'During the experiment there were moments in which I felt as if the virtual arm was my own arm', to which they responded with a median score of +2. Concerning full virtual bodies, Lenggenhager et al. (2007) presented their participants with a 'self-attribution' questionnaire which included the statement, 'It felt as if the virtual body was my body', to which they responded with a mean score of 2.3. Consistent results have been reported in a number of subsequent studies (Kilteni et al. 2015).

3.2.2. Agency

In the VR literature, the sense of agency is a broad term encompassing 'the subjective experience of action, control, motor selection and the conscious experience of will' (Blanke and Metzinger 2009, 7). Naturally, users experience agency over virtual avatars they control through motion-tracking (Kong et al. 2017), analogous to that experienced when participants control a hand in situations analogous to the rubber hand illusion (Tsakiris et al. 2005; Longo and Haggard, 2009; Tsakiris et al. 2010), even despite major incongruencies between motor activity and visual feedback of the kind described above (Kannape et al. 2010). However, in a recent study, Kokkinara et al. (2016) studied users' agency for the actions of virtual avatars they observed whilst remaining passive. Their

participants wore a head-mounted display, and, whilst seated, were presented with images of an avatar walking. Despite not engaging in the relevant movements, participants responded to the questionnaire items 'During the experiment I felt that the leg movements of the virtual body were caused by my movements' and 'I felt that I was walking' positively (with median scores of 1 and 2, respectively).

3.2.3. Self-location

Research on mental representations of the body employs the term 'self-location' to refer to the experience of occupying a determinate spatial location that may or may not be coincident with one's body (Lenggenhager et al. 2009). This general sense of the term has been adopted by VR researchers, though it is often with a slightly more specific meaning. For instance, the notion is sometimes used as a means to distinguish the feeling of presence in a virtual environment from the feeling of being within a virtual body (Kilteni et al. 2012, 375–76). By contrast, questionnaire items purporting to measure the experience of self-location often concern the distinction between the subject's actual location and their experienced location: for example, 'I experienced that I was located at some distance behind the image of myself, almost as if I was looking at someone else' (rated 1.5 on a -3 to +3 scale) (Ehrsson 2007); 'It felt as if I were lying in the corner of the room, looking at the MR scanner from this perspective' (rated 8 on a 0–10 scale) (Guterstam et al. 2015). Indeed, some researchers have used VR as a means to induce experiences analogous to out-of-body experiences (Ehrsson 2007; Lenggenhager et al. 2007; Ionta et al. 2011).

3.3. Virtual embodiment and flexibility

Although virtual avatars are typically humanoid, VR researchers have begun to explore the boundaries of the range of virtual avatars that participants can embody, by presenting individuals with avatars that are very different in physical characteristics to the participants' actual bodies.[7] Here is a representative list of manipulations of this kind, each of which used motion-

[7] It is also noteworthy that while, for instance, the rubber hand illusion typically fails for 'non-corporeal' objects, such as a block of wood (Tsakiris et al. 2010), it does not seem to itself depend upon similarity between the rubber hand and the participant's actual hand (Longo et al. 2009). Moreover, recent work has demonstrated that similar paradigms can be used to illicit the illusion of having a sixth finger (Newport et al. 2016) or as many as four hands (Chen et al. 2018). We welcome the trend towards probing the boundaries of illusions such as these, not least because they might reveal the extent to which our self-ascriptions can be flexible.

tracked virtual avatars, and each of which found comparable results on appropriately modified versions of the questionnaire items described in the previous subsection:

- Piryankova et al. (2014) presented participants with avatars of drastically altered hip, waist and shoulder width corresponding to the shape of overweight or underweight individuals.
- Banakou et al. (2013) presented adult participants with an avatar the size and shape of a typical four-year old.
- Slater et al. (2010) presented male participants with an avatar shaped like a female.
- Banakou et al. (2016) presented light-skinned participants with dark-skinned avatars.
- Steptoe et al. (2013) presented participants with 'extended' humanoid avatars, which were humanoid in shape but with the addition of a tail.

The accumulation of data of this kind might be taken as *prima facie* evidence for flexibility. In sum, individuals' self-ascriptions may range not only over real bodily properties and processes but also virtual properties and processes. Moreover, VR seems to not only afford demonstration of the flexibility of the self-concept, it also seems well suited for systematically studying it. Thus, by appropriately manipulating the presentation of various kinds of avatar, one might systematically study subjects' categorization of various kinds of object as themselves.

4. Some methodological issues

Despite its obvious prospects, there are two significant methodological issues to be faced in using VR to study the flexibility of the self-concept. Both concern the degree of similarity in context between patterns of self-ascription that do and not involve the use of VR technology. The first issue is that it is possible that VR engages users' imagination, placing them in an imaginative context in which they engage in patterns of self-ascription that are sheared off from their actual conception of themselves. The second issue is that VR alters users' perception to such a degree that their thoughts about the relationship between a virtual body and themselves and their actual body and themselves have a very different structure.

4.1. Imagination and VR

The questionnaire items commonly used in VR clearly require subjects to employ the self-concept in identifying properties of avatars as properties of themselves. But they do so by asking subjects about their experience of properties in VR, using qualifying conjunctions such as 'like' or 'as if'. This reflects a similar practice in the construction of questionnaire items used to test the rubber hand illusion and items used to test the experience of virtual embodiment (cf. Longo et al. 2008; Dobricki and de la Rosa 2013). However, the phrasing is equally compatible with the hypothesis that subjects are using the self-concept in a form of pretence (Nichols and Stich 2000), reflecting on a previously unnoticed imaginings in a manner similar to the experience of fiction (Walton 1978).

To illustrate, consider how such an account would proceed for the experience of body ownership reported in the rubber hand illusion (Alsmith 2015). The explanation is that these participants are imaginatively perceiving a rubber hand as their own. In imaginative perception, objects of perception are experienced in accordance with what one imagines at the time. Often when we imaginatively perceive, we imagine a perceived object to be something it is not, such as seeing Laurence Olivier as Hamlet (Currie and Ravenscroft 2002, 29), a triangle as a bully (Heider and Simmel 1944, 247) or a glob of mud as a pie, in a game of make-believe (Walton 1978, 11). Along these lines, Alsmith (2015) suggests that, in the rubber hand illusion, as participants see a rubber hand being stroked whilst they are feeling a hand being stroked, they imagine that the rubber hand that they see is their own hand. This raises the possibility that, in VR studies, participants are seeing a virtual body and imagining that the body they see is their own. It is imagining that the object that they see is their own, that leads participants to report experiencing it as their own, by responding affirmatively to the relevant questionnaire items.

A fuller account on similar lines would need to clarify exactly how the imagining is itself facilitated by the content of perception. But, roughly, the thought would be that the imaginative experience is facilitated by the consistency between the content of perception and the proposition that they have a virtual body (Walton 1978). As a consequence, the experimental setup fosters the participant's imagining that the virtual body is her own, without her needing to engage her imagination actively, or indeed attend to the fact that she is imagining (Walton 1990). For a comparison: when watching a play, I need not intend to imagine that the actor I see onstage is the character she plays, nor will I necessary notice if I do so imagine that to be the case. Yet, if her performance

is compelling, I may naturally be caught up in the imaginative project. Similarly, a compelling experimental setup might facilitate a participant in engaging a fictional scenario in which she imagines that she has a virtual body.

We do not mean to suggest that this interpretation of user experience in VR is in any way exclusively supported by the available data. Rather, we present it as a possible interpretation because of its implications for the use of VR to study flexibility. Imagination is notoriously unconstrained by reality. For this reason, imaginative contexts can constitute a significant departure from contexts in which our thoughts *are* more constrained by reality. This feature of the imagination is well captured by Nichols and Stich's (2003, 2000) model of pretence. According to their model, what we believe on the one hand and what imagine on the other is a consequence of mental operations on propositional contents stored in different 'boxes'. Whereas believing involves operations on contents stored in the 'Belief Box' – contents which serve to represent states of affairs in the actual world, imagining involves operations on contents stored in the 'Possible World Box' – contents which, perhaps unsurprisingly, represent states of affairs in possible worlds.

If it is indeed the case that VR users' self-ascriptions reflect their imaginative experiences, then it ought to significantly affect how we model the flexibility of their self-conception in this regard. For whilst it might be the case that there is a great degree of difference in the kinds of entities involved in their pattern of self-ascription (placing their self-conception high on dimension 1), there is also a great degree of difference between the imaginative contexts of their self-ascriptions in VR and the non-imaginative contexts of their self-ascriptions outside VR (placing their self-conception low on dimension 2).

4.2. Thinking about virtual bodies and real bodies

Determining where an individual's self-conception falls on dimension 2 requires a clear understanding of each context in which subjects can apply the self-concept, in order that they might be compared for similarity. One way in which contexts might be similar or different is in the structure of an individual's self-ascriptions *within* each context. The example we will focus on is the structure of an individual's thinking about the relationship between their actual bodies and themselves.

The human body is an integrated structure of parts forming a whole. Since at least the 1970s, researchers have used a variety of methods to determine whether and how individuals locate themselves within specific parts of their body. Some

of this work has relied upon manipulating subjects' attention towards parts of their bodies to elicit judgements of their location in relation to those parts. For instance, in an early study by Dixon, participants were asked to manually stimulate various body parts to and answer various questions about the relative location of these parts to the 'vantage point of "I"' on three spatial dimensions and thereby provide a 'three-dimensional fix on locus of self' (Dixon 1972, 104). In more recent work, Bertossa et al. (2008) used a structured interview which also consisted of a series of questions about the relative spatial location of body parts to the 'I', which they used to elicit gradually narrowing self-location judgements to a single bodily location.

Other studies have had participants make projective judgements about the location of the self in a depiction of humanoid or non-humanoid figures. For instance, Limanowski and Hecht (2011) provided participants with a description of the notion of the self and asked participants to mark the location of the self within an outline of a human body and within a rectangular shape containing depictions of a human heart and brain. Starmans and Bloom (2012) used a slightly less direct method in which participants (children and adults) were asked to judge the relative distance of an object from a humanoid a character with a humanoid or alien body.

These approaches have produced somewhat mixed results concerning individuals judgements of the location of the self within the body. Whilst Starmans and Bloom's (2012) results clearly suggested that 'children and adults intuitively think of the self as occupying a physical location within the body, close to the eyes' (Starmans and Bloom 2012, 317), Limanowski and Hecht's (2011) participants' responses clustered around both the head and torso of the outline of the human body. And whereas 51 of Bertossa et al.'s (2008) 59 interviewees judged themselves to be centred within their heads, this was true of only 40 of Dixon's (1972) 80 respondents.

Modifying a paradigm used to study binocular vision, Alsmith and Longo (2014) developed a method for eliciting precise self-location judgements concerning one's own body, rather than a depiction of a body, which also allowed specification of multiple bodily locations across trials.[8] We found a clear bimodal distribution of judgements between the upper-face and upper-torso. Taken

[8] We adapted a version of a task developed by Howard and Templeton (1966), originally designed for locating the point of projection of binocular vision. The task required subjects to manually align a visually presented rod along the horizontal plane such that the near end pointed 'directly at himself'. We adapted this task, requiring subjects to align a rod along a sagittal plane, with individual trials split equally between two directions of rotation (upwards or downwards). See Alsmith and Longo (2014) for further details.

together with previous results, this suggests that when someone thinks about her body as herself, she does not necessarily identify with the body *simpliciter*, nor does she necessarily identify with a single part of her body exclusively. Rather, her thinking might be structured around particular body parts.

Identification with particular body parts might vary across judgements according to a range of contextual factors. For instance, in our study, the pointer that was used to pick out bodily locations rotated in the sagittal plane, moving from either an upwards starting direction or a downwards starting direction. Our participants were clearly affected by the starting direction, effectively resolving the choice between two likely locations (upper-face vs upper-torso) by which one came first. We suspect that other contextual factors might have affected the results of the previous studies described above. Indeed, we think that this serves to illustrate the generally thorny issue of determining precisely which contextual factors might influence an individual's self-ascriptions, and thus determining similarity or difference of context.

Moreover, we suspect that this problem is particularly acute in VR studies. For the use of VR technology might introduce a range of distinctive contextual factors due to the fact that it remains a predominantly visual medium. Here it is noteworthy that the vast majority of refinements of sensory displays in recent years has focussed on visual displays (Cummings and Bailenson 2016). In a recent study, we adapted our 2014 method to VR, by presenting a virtual pointer to participants using a head-mounted display (Van der Veer et al. forthcoming). We found a very strong preference for upper face responses, with the majority of participants (16 of 23) additionally reporting that they intended to point to their heads. These initial results suggest that simply wearing a head-mounted display might affect how individuals think about the relationship between their bodies and themselves. But further work is required, particularly incorporating avatars, and using a variety of display technologies. More generally: without parallel studies using comparable methods, the similarity or difference between VR and non-VR contexts of self-ascription remains unclear.

5. Conclusion

Contemporary experimental philosophical work on the self has principally been focused on essentialist notions of selfhood, and especially their relations to moral judgements (see e.g. Newman et al. 2015) and intentional action (see e.g. Sripada and Konrath 2011). In this chapter, we have offered a complementary approach, focusing not on what might remain constant in an individual's conception of the self, but rather on the degree to which it might involve properties attributable to various kinds of entities.

We have suggested that flexibility can be captured by placing pairs of self-ascriptions on two dimensions of higher-order difference/similarity. The first dimension concerns the degree of difference in the range of entities to which self-ascriptions are made, where greater difference yields greater flexibility. The second dimension concerns the degree of similarity between the contexts in which self-ascriptions are made, where greater similarity yields greater flexibility.

The methodological focus of the chapter has been on the use of VR technology as a means to investigate flexibility. Under certain conditions, this technology is sufficient to induce subjects into various forms of illusion in which they might categorize various kinds of virtual objects as themselves, thereby serving to demonstrate flexibility on the first dimension. However, we have highlighted two significant issues to be faced in determining the degree to which these self-ascriptions are flexible on the second dimension: the possible role of the imagination in users' experience of VR; and the perceptual differences resulting from the use of contemporary display technologies.

If self-conceptions are indeed flexible, the implications that this has for the nature of the self-concept, and thus the nature of the self, are surely significant, even if not entirely obvious. In any case, it would seem strange for a comprehensive theory of selfhood to ignore the range of entities encompassed by an individual's pattern of use of the first-person concept. For this would be a theory of selfhood that ignored how individuals conceive of themselves. However, the ease with which we may be prone to flit back and forth, happily equivocating on that which we conceive ourselves to be, ought to give pause on the extent to which any robust metaphysical theory of the self can avoid being revisionary.

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6

Experimental Economics for Philosophers

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1. Introduction

Over the last 20 years or so, game theory and evolutionary game theory – mathematical frameworks from economics and biology designed to model and explain interactive behaviour – have proved fruitful tools for philosophers. Ethics, philosophy of language, philosophy of cognition and mind, social epistemology, philosophy of biology, social science and social and political philosophy, for example, all focus on questions related to human interaction, meaning that game theory and evolutionary game theory have been useful in illuminating problems of traditional interest in these fields.

This methodological osmosis is part of a larger trend where philosophers have blurred disciplinary lines in order to use the best epistemic tools available when tackling the questions that interest them. In this vein, experimental philosophers have drawn on practices from the social sciences, and especially from psychology, to expand philosophy's grasp on issues from morality to epistemology to consciousness.

In this chapter, we argue that the recent prevalence of formal work on human interaction in philosophy opens the door for new methods in experimental philosophy. In particular, we discuss methods from experimental economics, focusing on studies of strategic behaviour, to show how these methods can supplement, extend and deepen philosophical inquiry. This branch of experimentation emphasizes induced valuation – the idea that if we want to understand strategic behaviour in humans, we have to create a situation which mimics the strategic structure of the world. In other words, we have to allow people to make real choices that will impact actual outcomes that they value, as opposed to, say, reporting what choices they would make in such a scenario. The experimental framework also uses minimal framing, on the assumption that we are looking for general behavioural patterns. This contrasts with some