

# Illusory Body Perception and Experience in Furies

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## Abstract

The Rubber Hand Illusion (RHI) is an illusion of body ownership. This study investigates the RHI in *furies*: people who manifest interest in anthropomorphic animals through various combinations of costuming, roleplay, identification with a *fursona*, and unusual bodily experiences. Furry culture suggests two ways furies could differ from non-furies in their RHI experience: (1) furies' malleable perception of bodily self and identity may result in stronger feelings of illusory experience; alternatively, (2) furies' identification with non-human animals may result in weaker feelings of self-ownership for a human prosthetic. Results support the latter hypothesis; furies felt less subjective embodiment compared to non-furies. Moreover, proprioceptive drift was predicted by the extent individual furies valued humanity and their human bodies. The less esteem furies had for humanity and their human form, the less drift toward the human rubber hand was observed. These findings suggest how embodiment is related to subjectivity, identity, and practice.

**Keywords:** Rubber Hand Illusion; Embodiment; Body Perception; Culture; Identity

## Introduction

Embodiment has been defined as the subjective awareness of, and self-coincidence with, one's own body (Longo et al., 2008). Research suggests that this pre-reflexive, bodily self-

consciousness is constituted and undergirded by complex processes of bottom-up and top-down modulation of multisensory integration (Tsakiris, 2010). Previous studies have investigated the influences of these processes by using the Rubber Hand Illusion (RHI), a bodily illusion in which participants experience a sense of ownership for a prosthetic human hand (Botvinick & Cohen, 1998). To perform the RHI, a prosthetic hand is placed inside the participant's peripersonal space in a position congruent with their real hand. Participants are then instructed to look at the rubber hand while it and the real hand are stroked synchronously with a paintbrush. When these incongruous visual and tactile stimuli are integrated, participants report experiencing the rubber hand as their own. Additionally, when the illusion of ownership of the rubber hand is successfully induced, participants exhibit proprioceptive drift, a tendency to perceive the location of their real hand as closer to the rubber hand than it actually is. Longo et al.'s (2008) principal component analysis of RHI questionnaire data found evidence for three dissociable subcomponents influencing the experience of embodiment of the rubber hand: "ownership"; "location"; and "agency". The two subcomponents of "ownership" and "location" were significantly correlated with increased levels of proprioceptive drift in the RHI, suggesting that both top-down "body-representation" and

bottom-up “body schema” influences converged to structure the experience of embodiment of the rubber hand.

Further experimental research on the RHI has supported the dissociation of these influences by either highlighting significant group differences in experience of the RHI or manipulating the RHI procedure itself. Findings supporting the influence of “body-representation” on RHI experience have found that incongruent positioning, shape, texture (Haans et al., 2008; Tsakiris & Haggard, 2005) and skin color (Lira et al., 2017) of the rubber hand attenuate RHI experience. Findings supporting the influence of “body schema” on RHI experience have found that asynchronous stimulation of the rubber hand attenuates the strength of the illusion significantly more than incongruence with body-representation (Armel & Ramachandran, 2003) and that populations with increased body-schema plasticity or flexibility such as individuals who are diagnosed with anorexia nervosa (Keizer et al., 2014), susceptible to out-of-body experiences (Braithwaite et al., 2017), hemiparetic (Llorens et al., 2017), psychosis-prone (Germine et al., 2012), or under the influence of dexamphetamine (Albrecht et al., 2011) demonstrate higher susceptibility to the RHI.

If previous research suggests (1) decreased illusory effects when individuals identify less with the form of the rubber hand and (2) increased illusory effects for individuals with greater body-schema flexibility, could the RHI be used to test hypotheses that interrogate the nature of body perception and experience in a unique population? *Furries* are self-identified fans of media featuring non-human animal characters who have been imbued with human-like traits (e.g., speech and bipedal walking; Gerbasi et al., 2008). As is typical with other media-based fandoms (e.g., science fiction; Jenkins, 1992), furries are both avid consumers and creators of fan-made artwork, animation, and writing (Plante, Roberts, Reysen, & Gerbasi, 2016a). They often share this interest with other fans, congregating primarily online, but also in-person at local meet-ups and at large-scale fan conventions (Mock, Plante, Reysen & Gerbasi, 2013). Illustrating the scope of these meetups, conventions such as Anthrocon, one of the world’s largest furry conventions, regularly attract more than 5,000 furries.

A subset of the furry fandom (approximately 20%) also expresses their interest through *fursuiting*, the wearing of elaborate, mascot-style foam-and-fabric costumes of furry-themed characters (Plante, et al., 2016b). Fursuiting is somewhat analogous to the practice of cosplaying among anime fans, who invest considerable time and effort into dressing up and interacting with other fans as their favorite character from a show (Reysen, et al., 2018). Unlike cosplay, however, fursuiting tends to involve characters of furries’ own creation.

One of the most universal activities in the furry fandom is the creation of a *fursona* – a non-human animal avatar imbued with human traits. Fursonas are used by furries as a representation of themselves within fandom spaces. Virtually all furries have a fursona, usually consisting of one or more non-human species, a name, and physical and personality

traits (Plante et al., 2016b). Furries spend a great deal of time creating, thinking about, and interacting with others in the fandom through their fursonas, with which they strongly identify (Plante et al., 2016b). This suggests the possibility that many furries may have a relatively malleable perception of self and body. For example, a furry may spend an hour or two per day interacting with other furries as their fursona, whose species differs from their own (i.e., not human), whose personality may differ from their own (e.g., more gregarious), and whose appearance, gender, and age may differ from their own. Given that prior research has shown that furries have fairly active imaginations and spend a great deal of time engaging in fantasy-themed activities (e.g., role-playing games and online roleplaying; Plante et al., 2016b), furries’ perception of bodily self and identity may be influenced by spending time engaged in furry-themed activities.

Speaking to this possibility, research suggests that some furries are likely to think of themselves as less than fully human and identify, at least in part, with non-human animals (Roberts et al., 2015). Furry conventions are also often attended by *therians* and *Otherkin*, those who have human bodies but experience themselves as something other than human (Gerbasi, Fein, Reysen, Plante, & Roberts, 2017). In contrast to non-therian furries, who may identify *with* a non-human species but usually understand themselves to be fundamentally human, therians identify *as* a non-human animal that exists or has existed on earth, such as a bear or a mammoth, while Otherkin identify *as* a creature usually considered to be mythological or fantasy-based, such as a fairy or unicorn. (*Note:* Although there are many therians and Otherkin who do not identify as furries, all therians and Otherkin in the current study also identified as furries.) Therians and Otherkin often report experiencing unusual bodily experiences, such as feeling phantom limbs belonging to the creature they identify as (such as claws, tails, or wings), and/or “shifts” into a mental state that they associate with their identified species. Many therians and Otherkin report experiences of deep discomfort with their human bodies and/or a desire to be in the body of the species with which they identify (Grivell, Clegg, & Roxburgh, 2014).

Presently, the RHI allows for testing between two competing hypotheses. If furries identify less with the human form of the rubber hand as compared to a control population then they should exhibit decreased RHI experience as a group. However, if furries have relatively greater body-schema flexibility, they should exhibit increased RHI experience. Results can inform our general understanding for how embodiment relates to identity, subjectivity, and practice.

## Methods

### Participants

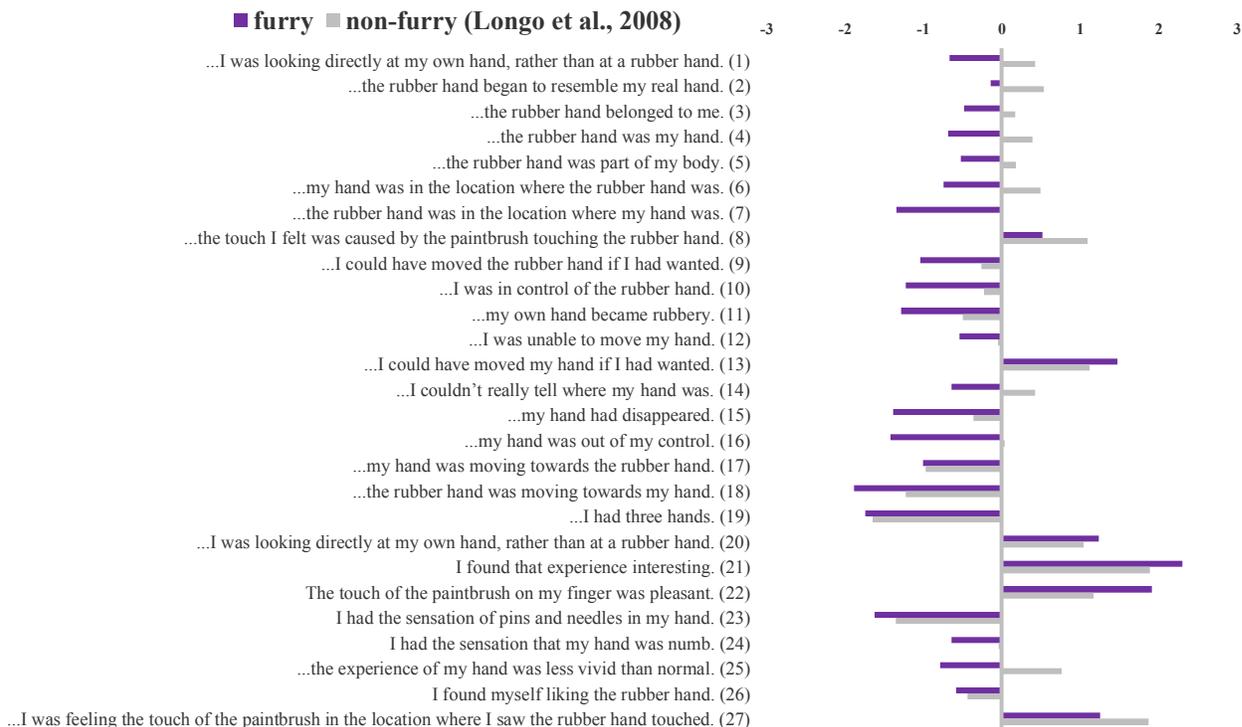
All participants were recruited and tested at Anthrocon 2018 in a quiet, private room. Of the 57 participants tested, two early participants’ data were not analyzed because they were recorded as having worn a ring or band-aid during the

procedure; one participant dropped out before completion; four other participants did not self-identify as furries in the subsequent survey. This left 50 furries for analyses ( $M_{age}=26.77$ ; 11 female/36 male/3 NA;  $M_{education\ years}=15.55$ ). For a comparison group of non-furries, we used raw data from 131 participants previously published in Longo et al. (2008).

## Procedure

**Rubber Hand Illusion** We used the procedure described in Longo et al. (2008) as a model to carry out the RHI in the current study but using only a right rubber hand (there was no effect of handedness in the original study) and an occluder box described by the JoVE Science Education Database (2019). (In this version, the participant can view the experimenter.) Participants sat across from the experimenter with their hand hidden inside the occluder and the rubber hand placed congruently in view. There were two blocks. At

the beginning of each block, participants estimated the location of the tip of their occluded right index finger by reporting the corresponding number on a ruler with a variable random offset (to prevent participants from using a remembered numeric label rather than a perceived location on subsequent trials). Following the pre-test location judgment, a 60s induction phase consisted of the visible rubber hand and occluded real hand being stroked with 2 identical paint brushes. In the *synchronous* block, individual fingers on each hand were brushed simultaneously; in the *asynchronous* block they were brushed 180° out of phase. (The asynchronous condition is frequently conceptualized as a kind of control or placebo, although subjective *deafference* scores have been observed to be higher in this condition.) Block order was randomized. After the induction phase in each block, participants were again asked to estimate the location of their index finger. Upon completion of the post-induction location judgement, participants filled out a



**Figure 1.** RHI embodiment survey items and response means. 7-point agreement scale; -3=strongly disagree; 0=neither agree or disagree; 3=strongly agree. (From Longo et al., 2008)

questionnaire assessing their subjective experience of the illusion (see Figure 1). This questionnaire, developed by Longo et al. (2008), measures 5 principal components (*embodiment of rubber hand, loss of own hand, movement, affect and deafference*) and three subcomponents of embodiment (*ownership, location, and agency*).

**Experiential Survey** After completion of both Rubber Hand Illusion blocks, participants filled out a survey with items designed to measure a number of variables related to their

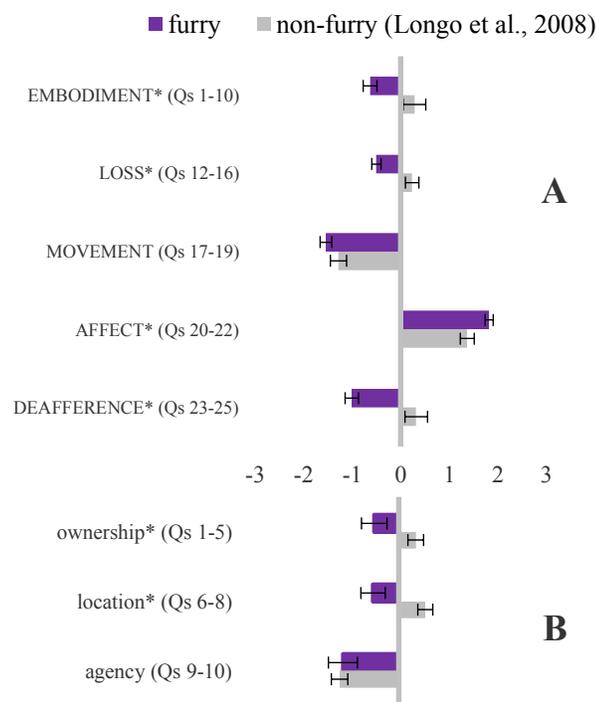
identity, experience, and attitudes, including questions about sexual identity, time since identifying as a furry and/or therian, and beliefs about being other than 100% human. The survey also asked systematic questions about the Duration (“How long ago did you start ...”), Frequency (“How often do you have...”), and Intensity (“How intense are...”) of relevant experiences and practices including: *Fursuiting, Role-Playing, and Online Interaction* with other furries. Two attitude scales were included as well (below).

**Humanity-esteem version of the Rosenberg Self-Esteem Scale** (Luke & Maio, 2009). This scale measures the extent to which participants think humanity is bad or good (“Human Value”). Example questions include, “I feel that the human species is very valuable, at least on an equal plane with other species in the universe;” “I feel that human beings have a number of very good qualities;” “All in all, I am inclined to regard the human species as a failure.”

**Identity version of the Transgender Congruence Scale.** We modified a previously validated gender congruence scale (Kozee, Tylka, & Bauerband, 2012) to measure the extent to which furry participants feel comfortable with the match between their identity and human body (“Human Body Image”). Example questions include, “My outward appearance represents my identity;” “I experience a sense of unity between my identity and my body;” “My physical appearance adequately expresses my identity.”

## Results

**Subjective Results Between Groups** (Figure 2A.) Compared to the non-furry population reported in Longo et al. (2008), furries appear to experience several critical principal components of the RHI to a lesser extent when asked identical questions [MANOVA:  $F(5, 175) = 9.72, p < .0005$ ; Wilk's  $\Lambda = 0.783$ ].



**Figure 2.** (A) Mean scores for Rubber Hand Survey principal components and (B) Mean scores for Embodiment item subcomponents. (\*) Indicates significant differences between furry and non-furry groups. All survey scores shown were recorded after synchronous condition except deafference scores which indicate responses recorded after asynchronous condition.

Post-test ANOVAs indicate that furries reported significantly weaker experiences associated with the principal components of *embodiment* [ $F(1, 179) = 11.22, p < .001$ ] and *loss* [ $F(1, 179) = 16.94, p < .0005$ ], (during synchronous condition) and *deafference* [ $F(1, 179) = 24.16, p < .0005$ ] (during asynchronous condition; See Longo et al., 2008 for more detailed explanation). Furries exhibited higher scores for *affect* [ $F(1, 179) = 7.69, p < .01$ ] (regardless of condition; i.e., in synchronous and asynchronous blocks) suggesting furry participants enjoyed the experience of being brushed irrespective of any illusory effects. There was no significant difference for *movement* (as non-furries also reported negative scores). (Figure 2B.) Furries indicated weaker subjective feelings for the critical embodiment subcomponents [ $F(3, 177) = 6.45, p < .0005$ ; Wilk's  $\Lambda = 0.901$ .] of *ownership* [ $F(1, 179) = 7.71, p < .0005$ ] and *location* [ $F(1, 179) = 13.38, p < .01$ ], but no difference for *agency*.

**Proprioceptive Results Between Groups** Proprioceptive drift is the tendency for participants to perceive the location of their real hand as closer to the rubber hand than it actually is. It is calculated by subtracting post-induction index finger location judgments from pre-induction location judgments in the synchronous block. Despite numerically smaller numerical averages for furries vs. non-furries, proprioceptive drift did not differ significantly for either condition.

Table 1. Proprioceptive Drift (cm) Between Groups and Conditions

Condition	N	Synchronous		Asynchronous	
		M	SD	M	SD
<b>Furry</b>	<b>50</b>	<b>0.76</b>	<b>3.73</b>	<b>0.05</b>	<b>3.57</b>
Non-furry	120	1.34	3.22	0.30	2.69

**Between Group Results Summary** Negative average values on relevant components, significantly lower than a large control sample, indicated lower subjective embodiment, loss, and deafference scores for furries. This suggests that identifying or role-playing as somewhat less, or other than human may be mitigating the strength of the RHI. That is, furries may experience the illusion to a lesser extent because they identify less with the human rubber hand.

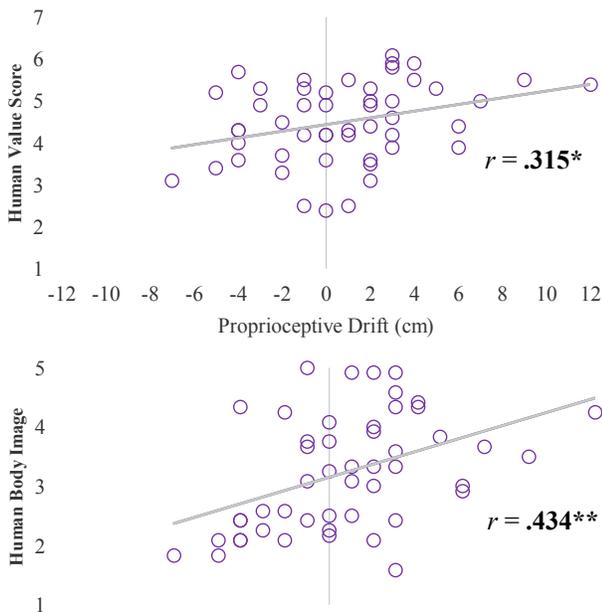
These results simultaneously appear to argue against the alternative hypothesis; that furry participants who actively move between human and non-human roles in terms of distinct individual identities and practices, might have a more plastic body schema as compared to non-furries. This hypothesis predicts larger RHI effects in furries when compared to a typical population. This was not the result.

Analyses focused on variability within the furry sample could sharpen our explanation. If furries are experiencing the illusion to a lesser extent because they identify less with the human rubber hand, then we should expect that the strength of the illusion for furries could be predicted by the extent to which individual participants value humanity and feel comfort in their human bodies

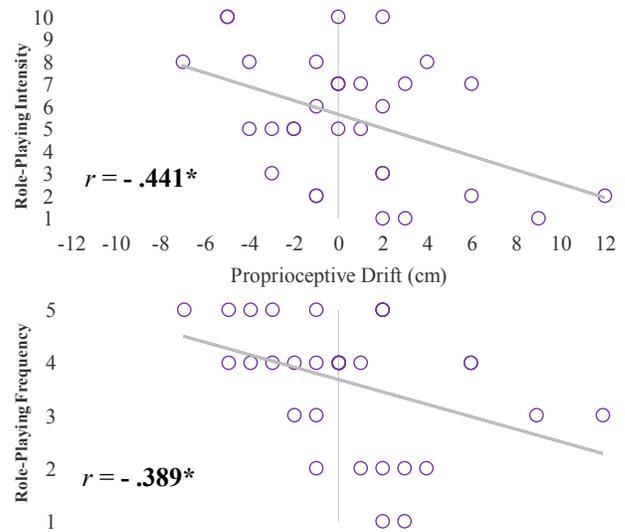
	Prop Drift	Human Value	Body Image	Furry Time	Human %	Wear Freq	Wear Intens	Wear Time	Role Freq	Role Intens	Role Time	Online Freq	Online Intens	Online Time
<b>Prop Drift</b>	<b>R</b>	<b>.315*</b>	<b>.434**</b>	<b>-0.092</b>	<b>0.192</b>	<b>-0.047</b>	<b>-0.087</b>	<b>-0.13</b>	<b>-.389*</b>	<b>-.441*</b>	<b>-0.267</b>	<b>-0.009</b>	<b>-0.002</b>	<b>-0.068</b>
	<i>p</i>	0.026	0.002	0.529	0.201	0.781	0.614	0.366	0.028	0.011	0.084	0.957	0.992	0.65
	<u>N</u>	50	49	49	46	37	36	50	32	32	43	43	43	47
<b>Human Value</b>	<b>R</b>		<b>.649**</b>	<b>0.188</b>	<b>0.157</b>	<b>-0.228</b>	<b>0.086</b>	<b>-0.003</b>	<b>-0.099</b>	<b>-0.236</b>	<b>-0.124</b>	<b>0.159</b>	<b>-0.078</b>	<b>-0.057</b>
	<i>p</i>		<0.001	0.195	0.297	0.175	0.616	0.986	0.591	0.193	0.429	0.308	0.621	0.703
	<u>N</u>		49	49	46	37	36	50	32	32	43	43	43	47
<b>Body Image</b>	<b>R</b>			<b>-0.038</b>	<b>0.28</b>	<b>-0.319</b>	<b>0.09</b>	<b>-0.008</b>	<b>-0.116</b>	<b>-.364*</b>	<b>-0.187</b>	<b>0.005</b>	<b>-0.075</b>	<b>-0.259</b>
	<i>p</i>			0.8	0.062	0.058	0.6	0.956	0.528	0.041	0.229	0.975	0.636	0.082
	<u>N</u>			48	45	36	36	49	32	32	43	42	42	46

Table 2. Correlations (**R**) 2-tailed significance values (*p*) and sample sizes (N) for relations between **Proprioceptive Effects** (Prop Drift), **Human Value and Body Image Questionnaires**, and **Furry Experience Data**. Furry Experience Data includes (1) Frequency in terms of hours per day (Freq) (2) Intensity of Experience (Intens) and (3) Time in Months since beginning a particular kind of practice, including (A) Fursuiting (Wear), (B) Role-Playing (Role) and (C) Online Interaction with other furries (Online). Also shown are correlations for time in months since first identifying as a furry (Furry Time) and the relative extent in percentage terms that participants identify as Human/Non-human (Human %). \* Indicates correlation is significant at the 0.05 level; \*\* correlation is significant at the 0.01 level.

**Proprioceptive Results Within Group** In furry participants, the extent of drift toward the rubber hand was positively correlated with individual scores on the **Humanity-esteem version of the Rosenberg Self-Esteem scale** (“Human Value”) and the **Identity version of the Transgender Congruence Scale** (“Body Image”), which were highly correlated with each other. This suggests that among furries, lower esteem for humanity and feelings of incongruence between one’s identity and human body is predictive of less proprioceptive drift towards the rubber hand (see Table 2 and Figure 3).



**Figure 3.** Correlations between individual proprioceptive drift scores (cm) and Human Value (7pt. scale, top) and Human Body Image (5pt. scale, bottom) scores. See Table 2.



**Figure 4.** Correlations between individual proprioceptive drift scores (cm) and Role-Playing Intensity (10pt. scale, top) and Frequency (5pt. scale, bottom). See Table 2.

There were significant negative correlations between individual proprioceptive drift scores and Role-Playing Intensity and Frequency Scores from the **Experiential Survey**. This suggests that among furries, more frequent and intense role-playing in a fursona is predictive of less proprioceptive drift towards the rubber hand (see Table 2 and Figure 4).

**Therian or Otherkin vs. Non-Therian Furries** (Table 3.) There were significant differences (MANOVA and post-test ANOVAs) between non-therian and therian/Otherkin participants and survey scores (Human Value and Body Image) predictive of Proprioceptive drift (which showed a marginal difference between these groups). Therians had lower Human Value and Body Image scores and predictably self-identified as less human than non-therian furries.

Table 3. Non-Therian Furrries vs. **Therian Furrries**.

	Human %**	Prop Drift	Human Value*	Body Image*
Non-therian (N=38)	98.19	1.32	4.71	3.43
<b>Therian (N=12)</b>	<b>61.50</b>	<b>-1.00</b>	<b>3.83</b>	<b>2.64</b>
<i>p</i>	<.0001	=.06	<.01	<.05

**General Results Summary** The overall pattern of results supports the hypothesis that furrries are experiencing a mitigated RHI because they identify less with the human rubber hand. **(1)** Compared to a control sample, furrries exhibit lower average and subjectively negative scores for relevant principal components of a validated RHI survey. **(2)** The extent of proprioceptive drift, which can be regarded as a more objective illusion index, is predicted by Human Value, Body Image, and Role-Playing scores in furrries. **(3)** Therians and Otherkin, i.e., furrries who identify *as* non-human, exhibit lower survey scores associated with human esteem and marginally lower scores for proprioceptive drift as compared to non-therian furrries.

## Discussion & Conclusion

The present study suggests ways that illusions of body ownership can be used to test distinct hypotheses - that make opposite predictions - within unique populations. Lira et al. (2017) found that individual differences in implicit racial bias modulated proprioceptive drift (and other measures of RHI magnitude). That is, higher racial bias in white participants mitigated drift toward a black rubber hand, suggesting that within-subject attitudinal differences can reduce proprioceptive effects. Elsewhere it has been suggested (Dempsey-Jones & Kirikos, 2014) that proprioceptive effects are relatively impervious to top-down modulation, suggesting that neurocognitive group differences in body-perception may be driving results in other groups (e.g., in autism) that show reduced RHI effects. While the results of this study suggest that furrries are less likely to identify with a human hand, they cannot determine if, broadly speaking, top-down or bottom up processes better describe why this is the case.

Despite these limitations (based principally on using a comparison data set from a previous study and correlational methods) the present study seeks to broaden the range of salient identity categories to studies of cognitive difference, joining the growing body of literature that explores the implications of variability in particular populations. We investigated a subculture whose membership is defined through a powerful and often embodied experience of affinity with a particular symbolic form – in this case, anthropomorphic animals. Our findings suggest that the kind of cultural differences that may not be visible to the eye or reportable on a typical demographic questionnaire, but manifest instead in self-identification with a particular community, subjective experience of difference, and ongoing participation in patterned cultural practices (Roepstorff,

Niewöner, & Beck, 2010), may be profoundly related to body perception. These findings argue for a broader conceptualization of cultural and identity difference than is often found in cross-cultural cognitive research – one deeply grounded in both subjectivity and practice.

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