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Individual Differences in Ownership Reasoning: A Twin Study

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Honours Psychology Thesis

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Abstract

Vast similarities in ownership behaviour across species and age ranges have been used to support the notion of an innate basis for ownership reasoning. Using a twin study paradigm, this is the first study to investigate the extent to which genetic and environmental factors contribute to individual differences in ownership reasoning. 65 pairs of adult monozygotic (MZ) twins, and 16 pairs of same-sex dizygotic (DZ) twins completed a 24-item ownership questionnaire, which included items on (1) new ownership and (2) appropriate transfers of ownership. For both of these factors, it was found that MZ correlations were larger than DZ correlations. Univariate model fitting analyses indicated that genetic and non-shared environmental factors could account for all individual variation on the two factors, with shared environmental factors contributing non-significantly; heritabilities ranged from .36-.57 over both factors. The results support the notion that individual differences in ownership reasoning have a significant genetic basis. It is proposed that future research look into the many other facets of ownership reasoning, and to explore their relationship and mediation via genetically influenced traits.

Individual Differences in Ownership Reasoning: A Twin Study

The rules and customs we use to establish ownership are often ascribed to human society (e.g., Bentham, 1914; Ellis, 1985). However, survival and reproduction require the proper materials (e.g., food, shelter, mates). Accordingly, many species have devised characteristic ways of responding to possessive behavior, presumably to reduce conflict (e.g., Brosnan, 2011; Stake, 2004). Based on the longstanding importance of property, it is reasonable to suggest that our own ownership reasoning may have evolutionary roots.

The Importance of Ownership

The importance of ownership extends beyond satisfying basic needs, to include a slew of psychological effects. In humans, these include an increase in preference, memory, and value for owned over non-owned objects (Friedman & Neary, 2008; Friedman, 2010). Parallel effects have been evidenced in non-human primates and birds, who have been shown to work harder to maintain an item in their possession than to acquire the same item (i.e., loss aversion, and the endowment effect; Brosnan, 2011; Stake, 2004). On a more general note, property has been suggested as one of the earlier forms of abstract thinking, as it can extend beyond current possession (Fasig 2000; Friedman & Neary, 2008).

In addition to psychological effects, ownership influences behavior. The way we act toward an object depends on whether the object is owned, and by whom. For instance, it would be inappropriate to write in or rip out pages from somebody's journal, unless given permission to do so. Whether learned or innate, a common understanding and respect for ownership regulates much of our behavior toward objects.

Extending beyond its effects at the individual level, an understanding of ownership is integral to social cooperation. Highlighting this social element, law defines ownership as

the relation between people in regards to an object (Stake, 2004). This relation involves mutual assent regarding the boundaries and rights incurred by ownership; without which, social order would be imaginably hard to maintain. Many authors and philosophers have supported this idea, going so far to claim that society would not exist without the establishment of property (Ellis, 1985). To elaborate, consider a society in which homes, businesses, and even this paper could be claimed by anybody so willing; with no respect for property, society could crumble. Consequently, the concept and understanding of ownership is an integral part of our society and cooperation as a species.

What is Ownership Reasoning?

Given its vast applicability across situations and species, it should come as no surprise that ownership reasoning is multifaceted and includes a range of questions. According to Friedman (2008) these include (1) what can be owned and by whom?, (2) what privileges are incurred by ownership?, and (3) who owns what? This final question can also be divided into (a) the ownership of already-owned objects, and (b) the ownership of non-owned objects (Friedman & Neary, 2009). In addition to these, there are also questions concerning appropriate transfers of ownership (e.g., borrowing without permission). For the purpose of this study, we will focus on the question of who owns what in terms of non-owned objects, and on appropriate transfers of ownership.

Ownership Reasoning in Humans

Adults have been shown to use a variety of heuristics when deciding on the owner of a non-owned object. Commonly, a “first possession” heuristic is used, in which ownership is granted to the first person to take physical possession (Friedman, 2008; Friedman & Neary, 2009). In other situations, adults have been shown to favor a person whose actions were

“necessary for possession” (i.e., caused the object to be owned, such as releasing a gem from a cliff; Friedman, 2010). Another more nuanced heuristic parallels attributions of responsibility. In this scenario, the “necessary for possession” heuristic will persist only if the agent’s actions were both under their control and intended (e.g., he/she forcibly removed a gem from a cliff, with the intention of getting the gem; Palamar & Friedman, 2012). In general, the decision of who owns what may be based on attempts to retrace the history of the object-in-question (Friedman, Neary, Defeyter, & Malcolm, 2011). Although it is unclear whether these patterns were learned or acquired, parallel heuristics have been observed in young children, which may suggest an innate basis.

From an early age children exert ample attention toward property, and as young as two develop heuristics similar to those found in adulthood. Highlighting the early emergence of property notions, Furby (1980) notes that possession is one of the first concepts expressed by toddlers, and already by 18 months some toddlers are able to distinguish ownership from current possession (Fasig, 2000).

Parallel to the first possession heuristic in adults, children as young as two show a bias to select first possessor as owner of an object in serial possession tasks (i.e., tasks in which one person possesses an object, followed by another person; Friedman 2008; Friedman & Neary 2008). Similarly, in observational studies, children from three years old will show less resistance to a “take attempt” (i.e., playmate attempting to take their toy) when the taker had prior possession, even if the current possessor is larger in stature (Hook, 1993). Children as young as three have also been shown to infer ownership in serial possession tasks based on which character controls permission (Neary et al., 2009). Beyond tangible objects, children from the age of six have been shown to use both the first

possession heuristic, as well as the control over permission heuristic, in relation to ideas (Shaw, Li, & Olson, 2012). Additionally, children from four years old have been shown to track ownership across exchanges; that is, they understood that owners could lose rights, and that non-owners could gain rights, under certain circumstances (Kim & Kalish, 2009). The early recognition of property speaks to a possible genetic basis for ownership reasoning, however it could still be argued that environment plays the supreme guiding role.

Some scholars maintain that our understanding of ownership is entirely regulated by convention (Bentham, 1914; Ellis, 1985). On the contrary, a common understanding to ownership shows resilience across cultures, and even in the absence of property laws. For example, Furby (1978) compared kindergartners as well as fifth graders from three different groups, differing by property customs: (1) American, (2) Israeli: non-kibbutz, (3) Israeli: kibbutz. Kibbutz is a communal settlement in which all private property is shunned, thus it offers a natural comparison group on which to study the effects of convention on ownership beliefs. Across all three groups, similar responses were given when asked the meaning of, and motivation to acquire, personal property. The only differences found were between American and Israeli groups, with no differences between the two Israeli groups. Another example comes from a country in Southeast Asia that currently has no effective laws regulating private land ownership: East Timor. In East Timor, land authority is typically claimed based on narratives of origin and first possession, wherein subsequent settlers argue for property rights based on their relationship with original owners (Fitzpatrick, McWilliam & Barnes, 2012). Thus the meaning of, and heuristics we use to understand ownership may have an innate rather than cultural basis. This idea is further corroborated with findings from other species.

Ownership “Reasoning” in Non-Human Species

A genetic etiology of ownership heuristics is suggested by the common strategies employed across species. One such strategy is termed “first in time, first in right”, in which members of a species that are first to the property-in-question are more likely to retain the property than those coming later in time. Greater than mere first proximity, physical contact appears to play a pivotal role in settling ownership disputes, similar to the first possession heuristic observed in humans (Stake, 2004). An example of this is provided with wood speckled butterflies, whose fighting lasts 10 times longer when both touch down on vegetation, versus only one. In many other species from damselflies to non-human primates, the first possessor will often win in a property dispute, even against a dominant competitor (Brosnan, 2011; Stake 2004). Furthermore, experimental data show that dominant male baboons will withhold any attempts to take a food item from a subordinate male that possessed the item first (Sigg & Falett, 1985). Given the absence of formal customs, the existence of similar property behaviour over such a diverse range of species speaks to a possible innate mechanism driving ownership behaviour.

Disentangling Genetics and Environment

Due to the similarity in property behaviour across species and age ranges, along with the overwhelming importance of property in survival, it is surprising that the origin of ownership reasoning is unknown. Although speculations have existed for at least a century (e.g., Bentham, 1914), the question is unanswered: Does our ownership reasoning have a genetic influence, or is it merely the product of social convention?

A common method used to parcel out genetic and environmental influences is the twin study. Twin studies can elucidate the role of genetics on individual differences via at

least two routes: (1) intra-twin correlations, and (2) model fitting. Intra-twin correlations involve computing the correlations between identical (i.e., monozygotic [MZ]) twins, and between fraternal (i.e., dizygotic [DZ]) twins. If the correlation is larger in the MZ twins than the DZ twins, this suggests a genetic influence.

Model fitting estimates the sources of individual variation in a phenotype (P). These sources include: additive genetics (A), common or shared environment (C), and unique or non-shared environment (E). MZ and DZ twins make ideal subjects for model-fitting of this sort because they only differ in terms of A. In summary, twin studies have the ability to estimate the contribution of environment and genetics toward variance on a given trait (see Rijdsdijk & Sham, 2002 for a review on twin studies).

Based on common trends from insects and non-human primates, all the way through to children and human adults, it is suspected that ownership reasoning may have a genetic basis. Thus, it is hypothesized that the correlation between twins on an ownership questionnaire will be higher in MZ twins versus DZ twins, and that the A component of our model will explain a significant proportion of the response variance.

Method

Participants

Adult twins were recruited from a previously established twin registry. The original registry recruited twins via newspaper and catalogue ads, and from a TV and movie-casting agency specializing in twins. Data were collected from 65 pairs of identical or monozygotic (MZ) twins (60 female pairs, and five male pairs), and 16 pairs of same-sex fraternal or dizygotic (DZ) twins (15 females pairs, one male pair). Participants ranged between 19 and 82 years ($M = 42.94$, $SD = 14.98$). All participants were entered in a draw for a one in ten

chance at \$100. The majority of participants were either Canadian or American; a small proportion of participants were from Europe or Australia.

Materials and Procedure

After reading a letter of information and consenting to participate, subjects received a mailed or an on-line (via FluidSurvey) booklet, each containing short instructions followed by a 24-vignette survey. The 24 vignettes yielded scores on two factors: (1) new ownership, and (2) borrowing without permission, with each factor containing 12 items. The vignettes were tested in an unpublished pilot study in which the full survey was found to have a Cronbach's alpha of .837, and the new ownership and borrowing factors were found to have reliabilities of $\alpha = .852$, and $\alpha = .942$, respectively (See full pilot study in Appendix A).

With permission, we borrowed the new ownership stories from a study by Palamer, Le, and Friedman (2012). Each story involved two male characters and a natural un-owned object (e.g., a coconut). The first character or *causal agent* allowed the object to become available (e.g., by kicking a soccer ball at a coconut, thus releasing it from its tree). Once the object became available, the second character or the *possessor* physically took the object (i.e., the coconut) and the two argued about whom rightfully owned the object. We used three base stories and varied each according to a 2 x 2 design, whereby the causal agent had intent or not, and control or not. Following each story was a statement that read "The [object] belongs to the [causal agent's name/possessor's name]". The name used in the statement (i.e., causal agent's or possessor's) was counterbalanced across questions within each survey. Participants were asked to rate their agreement to each statement on a 7-point scale (1 = *totally disagree* and 7 = *totally agree*). Below is an example of an intent x no control story:

Isaac is out paddling his rowboat in the bay. He sees a beautiful shell high on top of a rocky sandbar, and decides he wants it. Using one of his paddles, Isaac tries to knock the shell into the water. He misses and instead hits some of the rocks at the base of the sandbar. The rocks tumble into the water, carrying with them the beautiful shell. James is swimming by the sandbar. He sees the shell floating in the water and grabs it. Isaac hurries over, and they begin to argue about who gets to keep it.

The shell belongs to Isaac: 1 2 3 4 5 6 7

The remaining 12 stories focused on borrowing without permission. In these stories, a borrower wanted to use and then return an item belonging to someone else, for either an important or non-important reason. The owner had either a surplus, or only one of the desired item(s). After each story read a statement, “It is acceptable/unacceptable for [borrower’s name] to use [owner’s name]’s [item]”. The two versions of this statement (i.e., “acceptable” or “unacceptable”) were counterbalanced across questions. The 12 stories were created using three different items and a 2 x 2 design crossing importance and surplus. Participants rated their agreement in the same way, using a 7-point scale. Below is an example of a not important x surplus story:

Leah needs a pair of dress pants because she wants to look nice while she goes out with a friend. Her roommate Mary has several identical pairs, but she is out of town for a few days. Leah decides she will wear one pair of Mary’s pants for the day, and then wash and return them.

It is acceptable for Leah to use a pair of Mary’s pants: 1 2 3 4 5 6 7

The twins were expected to complete the questionnaire in an hour or less, and this was done on their own time. After completion of the survey, twins read a debriefing form

and were given contact information should they have any questions regarding the study.

Data Analysis

All twins rated their responses to each of the 24 items on our questionnaire, and means and standard deviations were obtained for the two factors. Correlations were computed to determine the average DZ correlation and the average MZ correlation for both our ownership and borrowing factors. Reliability statistics were also obtained for both of these factors.

The contributions of genetic and environmental factors on individual differences were estimated using univariate model-fitting, with the software package Mx (Neale et al., 1999). A “full model”, which will always provide the best fit to data, estimates the relative contributions of additive genes (A), shared environment (C), and non-shared environment (E) on individual differences. Reduced models can also be fit to see whether one or more of the A, C, and E factors can be dropped without a significant worsening of fit. For example, a CE model can be used to test whether purely environmental factors can account for the data without a significant worsening of fit. In our analyses, we compare the ACE model with reduced model options using the Akaike information criterion (AIC). The more negative the AIC value, the better choice the model. As mentioned, the ACE model will always provide the best fit, so a more negative AIC value is adjusted based on goodness of fit as well as parsimony.

Results

With all possible scores ranging from 12 – 84 per factor, the participants showed considerable variation for the “ownership” factor ($M = 52.90$, $SD = 14.66$), and for the “borrowing” factor ($M = 40.48$, $SD = 19.13$). It should be noted that each factors was looked

at individually, and the total score was not considered because there was virtually no correlation between factors ($r = .027$).

Table 1 summarizes the genetic analyses and includes: Cronbach's alpha for each factor, intra-twin correlations for MZ pairs and for DZ pairs, the parameter estimates for additive genetics, common environment, and non-shared environment (a^2 , c^2 , e^2) within each model, and the AIC to compare the full ACE model with reduced model options. Both the full ACE model and the reduced AE models are included in Table 1.

As can be seen in Table 1, MZ correlations are larger than DZ correlations on both factors, indicating that genetic contributions are present. Model-fitting analyses, also presented in Table 1, reveal that the best quality model for both factors includes the additive genetic (a^2), and non-shared environmental (e^2) factors, with heritabilities ranging from .36 - .57. According to the AIC, the AE model provides the best-fitting model for both factors, on grounds of parsimony (Table 1). Thus, for both factors, non-shared environment and additive genetics accounted for the greatest amount of variance, with shared environment contributing non-significantly.

Table 1

Internal Reliability and Genetic Analyses on Ownership and Borrowing Factors

Factor	α	Correlations (r)		Model	Parameter estimates (95% CI)			AIC
		MZ	DZ		a^2	c^2	e^2	
Ownership	.905	.58	.39	ACE	.37 (.00-.59)	.04 (.00-.53)	.59 (.41-.81)	-5.04
				AE	.41 (.19-.59)		.59 (.41-.80)	-7.04
Borrowing	.949	.72	.56	ACE	.36 (.00-.71)	.20 (.00-.65)	.44 (.29-.64)	-5.30
				AE	.57 (.37-.71)		.43 (.29-.63)	-7.10

note. MZ = monozygotic twins; DZ = dizygotic twins; A (a^2) = additive genetic variance; C (c^2) = shared environmental variance; E (e^2) = non-shared environmental variance; AIC = Akaike information criterion.

Discussion

The origins of our ownership reasoning have been long contested, with many authors arguing for a purely conventional origin (e.g., Bentham 1914; Ellis, 1985), and others acknowledging the possibility of a genetic influence (e.g., Stake, 2004; Brosnan, 2011). In the first attempt to empirically resolve this issue, we postulated that genetics would play a significant role in accounting for individual differences in ownership reasoning.

In support of our hypotheses we found that for both new ownership and borrowing without permission factors, genetics accounted for a significant proportion of response variance. This is consistent with the view that our ownership reasoning has an innate basis, which has been postulated by a number of authors (e.g., Stake, 2004; Brosnan, 2011; Nancekivell, Vondervoort, & Friedman, 2013).

In prior studies, researchers had posed an innate source of ownership reasoning based on observed similarities across species, or between age ranges, as well as the early emergence and central importance of property from such a young age (e.g., Bakeman, & Brownlee, 1982, Stake, 2004; Brosnan, 2011; Nancekivell, Vondervoort, & Friedman, 2013). However, these authors had generally limited their discussion to the establishment and respect for new ownership. In recognition of this, we had incorporated questions of this sort and these comprised our first factor of “ownership”. It is reasonable that new ownership reasoning in particular may have an innate basis because the requirement of keeping track of ownership transfers is minimized, thus easing its emergence at early ages and in species without complex cognitive capacities. In addition, new ownership judgments can be developed in numerous species through the use of a simple first possession heuristic. Due to the observable characteristics of possession, this heuristic may proceed without any formal

conventions or language, promoting its evolutionary development.

Although many authors proceeded from heuristics on new ownership to postulate a genetic origin of our ownership reasoning, it is unclear whether they had intended to include all aspects of ownership, or only new ownership. At least one author, Stake (2004), had reasoned that our “property instinct” involved other facets such as what to do with property. Similarly, other authors had proposed an innate basis for our ownership reasoning, without specifying any subsets to which that would be confined (e.g., Bakeman, & Brownlee, 1982). Thus, although new ownership was emphasized in the literature, we chose to include a “borrowing” factor as well, which was based on pilot study analyses of our ownership questionnaire (see Appendix A). Interestingly, this factor also showed a significant genetic influence on response variance. Although, due to the complexity of borrowing without permission, it is harder to ground this factor within evolutionarily stable behaviours across species and age ranges, and its development seems more reliant on human language and convention. Nonetheless, the genetic influence on response variation was similar across factors.

Moving on from concepts of ownership, the heritabilities that we found for our two factors are very similar to those that have been found for most personality traits, and for a number of attitudes (Olson, Vernon, Harris, & Jang, 2001; Johnson, Vernon, & Feiler, 2008). For instance, an accumulation of behavioural genetic studies over the past 50 years had indicated an average heritability coefficient of 0.48 for personality traits, which is quite close to the heritabilities we found, ranging from 0.36 – 0.57. In addition, most of the individual differences in personality traits studied in the 50-year review were accounted for by genetic and unique environmental components, with shared environment contributing

non-significantly (Olson, Vernon, Harris, & Jang, 2001). This is also what we found for our two factors.

The Nature of Ownership Reasoning

In recognition that both environmental and genetic factors contribute to ownership reasoning, it is worthwhile to consider how these components might affect phenotypic variation. For instance, it is unlikely that there are any direct genotype-phenotype relationships. In contrast, authors have speculated that there exists an innate predisposition to learn social rules, especially those relating to property (Bakeman, & Brownlee, 1982). It is unclear whether this idea would hold for all aspects of ownership reasoning however, as there seem to be almost universal heuristics governing property behaviour, at least in regards to new ownership. Similarly, if humans were born with an innate disposition to readily acquire ownership behaviour, then you would expect to find a greater proportion of response variation attributable to environmental factors, and more cross-cultural variation. Another possibility is that we are biologically prepared to recognize possession through first physical contact, and that our behaviour and opinions toward transfers of ownership and property disputes vary depending on a number of mediating factors, which can include a multitude of traits and attitudes. The idea that we have a biological mechanism to recognize physical possession was advanced by Stake (2004), who highlighted the existence of mirror neurons in primates that fire when viewing another primate grasping an object. Stake purported that these mirror neurons could assist in recognizing and remembering a first possessor. However, it is unlikely that recognition of physical possession would play a role in all facets of ownership reasoning.

Although authors generally refer to ownership reasoning as if it were a single and

uniform factor (e.g., “property instinct” from Stake, 2004), the two factors that we measured showed virtually no correlation. This raises the question of whether ownership reasoning is properly conceptualized as a number of independent facets, or whether its facets are essentially interdependent. We did not cover all aspects of ownership reasoning, so it is also possible that there are independent as well as interdependent facets of ownership reasoning, which could potentially reveal a factor structure in time. It is reasonable to suggest that other variables, such as personality traits or attitudes, could mediate the response patterns observed within and between ownership facets.

It is worth considering whether the ownership factors we measured represent a portion of some ownership personality trait constellation, whether the factors are proxies for some sort of possessive or social attitudes, or whether they represent some trait-attitude combination, or something entirely different. If our factors do not represent their own trait or attitude category, then there are likely personality traits and/or attitudes that mediate ownership responses. Alternatively, ownership response patterns may mediate attitudes and/or traits. Each of these questions could be investigated in future studies to more thoroughly understand the nature of ownership reasoning.

Limitations of Our Study

Our study focused on only two facets of ownership reasoning, yet there are many more aspects that were not incorporated (e.g., borrowing with permission, what can be owned, sanctions for the violation of property rights, etc.). Additionally, we chose our factors based on past research, as well as from factor and correlation analyses from a lengthier version of our ownership questionnaire (Appendix A). However, due to a lack of research, it is unclear whether these factors are temporally reliable, or whether they are valid

and/or complete subdivisions of ownership reasoning. Future research is needed to develop a more comprehensive measure of all ownership reasoning facets. This can assist in understanding their interdependence, and eventually their relationships to participant qualities.

In addition to our questionnaire only covering a portion of all ownership facets, the method of self-report has inherent issues. For instance, it is possible that there was a social desirability bias, especially in regard to our borrowing without permission factor. Borrowing without permission is generally not well received, so participants may have felt compelled to respond accordingly. However, participants were able to complete questionnaires at home on their own time, without any supervision, and with guaranteed anonymity, so this is not a pressing concern. Another problem with self-report is that responses may not coincide with actual behaviour. Regardless, our focus was on ownership reasoning for this study, and less so on ownership behaviour, so this question is not particularly relevant.

Other limiting factors of our study are related to our participant qualities. For one, we only had 16 pairs of DZ twins, which was not ideal; we hope to continue collecting data to resolve this issue. Another concern is that most of our participants were female, and so our population may not generalize to males. Additionally, without many male participants, it was not possible to detect gender effects on our ownership reasoning factors. In this regard, past research has shown that women may be more open to sharing, which could presumably affect response patterns to the borrowing without permission factor (i.e., to be more permissive; Rudmin, 1990). Further, research has shown male ownership behaviour to relate to competition and dominance whereas in women, ownership behaviour has been more closely related to personal achievements and social attachments (Rudmin, 1990). With this

in mind, it is possible that males may have a more uniform adherence to heuristics such as the first possession heuristic, in which there appears to be an observable “winner” in the situation. Support for this idea comes from the observance that male baboons would not attempt to take a food can from a subordinate male baboon, if the subordinate baboon had first possession of the food can. In contrast, female baboons did not show this pattern (Sigg & Falett, 1985). It is possible that heuristics for new ownership could be more strictly adhered to in males since evolutionarily, males would be typically exposed to more competition for resources, and thus benefit more from a disposition to reduce property disputes (such as adoption of a first possession heuristic).

Finally, twin studies adopt assumptions that are occasionally of concern to critics. Assumptions include the independence of genetics and environment, as well as an assumed equal amount of shared environment between MZ twins and DZ twins. Independence of genetics and environment most commonly includes concerns of assortative mating, genetic-environment interaction, and genetic-environment correlation. Each of these issues can be investigated more thoroughly if necessary, though they are not of particular concern for our current study.

Conclusions

Individual differences in ownership reasoning were shown to reflect not only environmental, but also genetic factors. However, our study only covered a small portion of ownership reasoning, and the effects of gender on ownership reasoning have yet to be examined. Future research is warranted to understand the connection between ownership facets, and their mediation via personality traits, attitudes, and biological factors. In any case, this study addressed a long posed question and opens the door for further research.

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Appendix A

Abstract

In inferring who owns what, preschoolers have been shown to use heuristics that can be paralleled in older humans and in nonhuman species. In fact, many of our possessive and ownership behaviors have been speculated to derive from evolutionary pressures. With this in mind, an innate basis of ownership reasoning has been postulated. In order to test this, we intend to use a twin study to parcel out environmental and genetic influences. A study of this sort requires a scale consisting of a number of ownership items, along with response options that allow considerable variation between subjects (i.e., more than two options). The purpose of this study is to design a reliable and valid survey for this end. A 40-item scale was used in the analyses, with stories involving ownership disputes over either: (a) newly discovered objects (deciding ownership) and (b) the transference of previously owned objects (discovering ownership). Factor analyses were performed along with reliability statistics. The survey was eventually shortened to 24 items with two factors, each of which showed high internal consistency. The resulting survey will be used in a twin study in order to test whether variance in responses is inherited or acquired.

The Sources of Individual Differences in Ownership Reasoning: a Survey and a Pilot Study

The importance of ownership is paramount in a world where survival and reproduction require the proper materials (e.g., food, territory, and mates); this is true for humans and other species alike. In order to reduce conflict, many species have shown characteristic ways of responding to possessive and ownership behavior; this may include evolutionarily rooted rules for reasoning about ownership (e.g., Brosnan, 2011; Stake, 2004).

Besides the satisfaction of basic needs, possessions can result in a slew of psychological effects. These include an increase in value, preference, and memory for objects that we possess, over those we do not (Friedman & Neary, 2008; Friedman, 2010). The understanding of ownership has also been implicated in the development of our concepts of self and others (Fasig, 2000). Without going into too much detail, Fasig posits that possessions allow us to form object-person links in memory that act as anchors for past, present, and future referencing.

Ownership also influences our behavior. Due to the privileges incurred by ownership, we will act differently towards objects based on who owns them. For example, it would be frowned upon to treat someone else's computer as our own unless the owner granted permission for such behavior. This is due to our understanding of ownership (whether learned or innate), and the rights that we assume follow.

Many authors have also pointed to the social aspects of ownership. Highlighting the necessity of social interaction, law defines ownerships as the relation between people in regards to an object (Stake, 2004). This relation involves mutual assent regarding the boundaries and rights of ownership; without which, social order would be unimaginably difficult to maintain. To elaborate, consider what the state of our society would be like if there were no respect for property. Our homes and other possessions alike would not be safe; the property of businesses

would be up for grabs to anyone who took the initiative to take it, and even scientific texts such as this one could be claimed by any individual with the motivation to do so. Thus, the concept of ownership is integral to the social cooperation of many species, and especially for the advanced and complex societies of humans.

Given the vast applicability of ownership in animal behavior and customs, it is not surprising that ownership reasoning can take many separate routes. For the purpose of this paper, we will focus on the question of who owns what. Authors have previously discriminated between different contexts in which this question applies: (a) regarding the ownership of non-owned things (“deciding” ownership), and (b) regarding previously owned things (“discovering” ownership). In both contexts, the use of rules and heuristics has been implicated in situations where ownership is not made explicit. These include inferring ownership from first possession¹, control of permission, temporal priority, actions necessary for possession, and/or basing ownership judgments on information relevant to attributions of responsibility (Brosnan, 2011; Friedman, 2008, 2010; Palamer, Le & Friedman, 2012; Neary et al., 2009). More generally, the decision of who owns what may be based on attempts to retrace the object-in-question’s history (Friedman et al., 2011).

Regardless of what specific rules are used, there is good rationale to argue that the origin of ownership reasoning is genetic. In multiple manuscripts, Friedman and colleagues postulate the existence of an innate basis for ownership cognition (e.g., Friedman & Neary, 2008; Neary et al., 2009). This is supported by findings that children as young as 18-24 months are able to distinguish ownership as separate from physical possession (Fasig, 2000). Additionally,

¹Writing this, I found it interesting that language for abstract concepts of ownership often seems linked to physical possession. For example: “to *take* ownership of”, “to *hold* rights”, “the item was *up for grabs*”.

Friedman and colleagues have shown that children as young as two use a first possession heuristic to infer ownership in serial possession tasks (i.e., tasks in which one character possesses an object, then the other character possesses it; Friedman, 2008; Friedman & Neary, 2008).

Children as young as three have also been shown to infer ownership in serial possession tasks based on which character controls permission (Neary et al., 2009). In addition, children from three to six infer that familiar artifacts (i.e., man-made objects) are likely owned objects (Friedman et al., 2011).

Research in nonhuman species provides another source of evidence for an innate basis of ownership reasoning. Stake (2004) outlines the ways in which rules of possession and ownership could be based on evolutionary pressures. In nonhuman species, he notes the use and possible reasons for a “first in time, first in right” heuristic, which is comparable to the first possession heuristic observed in humans. For example, he notes that intruders (i.e., those coming later in time) commonly fail to take over property rights, even when they are bigger in stature. This is assumed to be the effect of increased motivation to protect possessions, and/or a sort of respect for the property of others that decreases the motivation of intruders to fight. Additionally, chimp and bird species have been shown (like humans) to value objects in their possession over those that they do not possess (see also Brosnan, 2011). Stake also points out that a number of species use third party involvement to protect property rights (e.g., ravens will help to defend the territory of conspecifics following intruders or invasion). Finally, he emphasizes possible evolutionary roots in the tendency for wills to extend ownership rights to kin (i.e., for the health and reproduction of their genes). The plentitude of ownership behaviors paralleled across species and age groups speaks to the possibility of a genetic basis for ownership judgments.

Twin studies are a common approach in behavioral genetic analyses used to parcel out the influences of environment and genetics. This is often done by using structural equations of the form $P = A + D + C + E$. Based on the different sources of genetic variance (i.e., additive [A] and non-additive [D]), and environmental variance (i.e., common [C], and unique [E]), these equations can be used make predictions on the various contributions towards a phenotype (P), against which real data can be compared. In twin studies, the degree of correlation between monozygotic (MZ) and dizygotic (DZ) twin pairs is known for the A, D, and C factors. Thus, a value can be determined for each of the equation's variables, communicating the degree of influence from the environment and genetics (for a review of twin studies, see Rijdsdijk & Sham, 2002). In essence, a twin study has the ability to estimate whether ownership reasoning is predominantly innate or acquired.

The present goal is to create a reliable and valid survey that can eventually be used in a twin study. We have developed a number of short vignettes about new ownership, and the transference of ownership; thus, both deciding and discovering contexts are investigated. The stories were given to pilot participants with the intent of developing a final survey to be given to twin pairs.

Methods

Participants

Younger adults ($M_{age} = 20.5$ years; $SD = 3.2$, age range 18-36 years) were recruited from the introductory psychology courses at the University of Western Ontario. Although 176 students were initially recruited, only 141 (80.1%; 125 females, 116 males) were included in all statistical analyses. Thirty-five participants' data were omitted due to missing scores. The subjects were asked to fill out an online survey, and they received partial course credit for their participation.

Materials and Procedure

After reading a letter of information and consenting to participate, subjects received an on-line booklet (via FluidSurvey) comprised of short instructions, followed by 40 ownership vignettes. The survey was constructed to include instances of (a) deciding ownership (new ownership), and (b) discovering ownership (borrowing with and without permission). With consent, the former was comprised of stories previously used by Palamer et al., (2012) in the study “Acquiring Ownership and the Attribution of Responsibility”. These stories involved two characters of the same sex, a pursuer and a possessor. The pursuer’s actions caused the object to become available (i.e., are “necessary for possession”), and then the possessor was the first to physically take the object. After the possessor takes hold of the object, the two characters argued about whom the object rightfully belonged to. Four base stories were used, and whether the pursuer had intent and/or control of their actions was varied across stories (leading to sixteen variations)². Each story was followed by a statement, “The [object] belongs to the [pursuer’s name/possessor’s name]”. The name used in the statement (i.e., pursuer’s or possessor’s) was counterbalanced across questions within each survey. Participants were asked to rate their agreement with the statement on a 7-point scale (1 = *totally disagree* and 7 = *totally agree*).

The borrowing-with-permission stories involved an owner who agreed to let another individual borrow an item of theirs. While the borrower was using the item (for either an important or non-important reason), the owner requested for the item back (also for an important or non-important reason). After each story was a statement, “[Borrower’s name] should/should not keep the [item] till he/she is finished”. Whether the statement includes “not” is

² One base story was changed such that the pursuer and possessor argued over a coconut in a tree, rather than a pineapple (Palamar et al., 2012 used a pineapple). This was sparked by a participant’s comment that pineapples do not grow on trees.

counterbalanced across questions within the survey. Like the new ownership vignettes, participants were asked to indicate their agreement with the statement on the same 7-point scale. The object used in each of these vignettes was estimated to be around \$80-\$200.

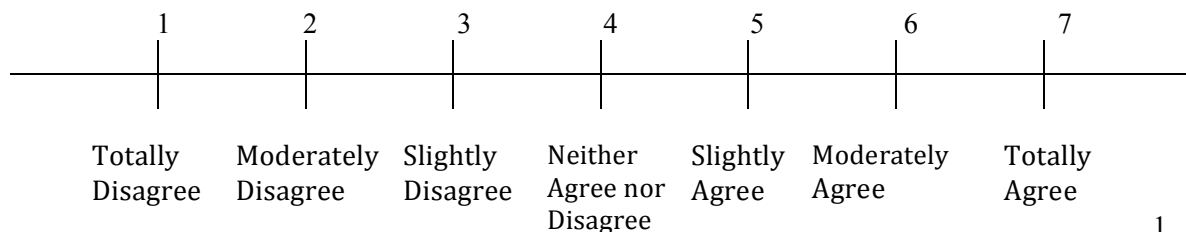
Finally, the borrowing-without-permission stories involved a borrower who wanted to use and then return an item belonging to someone else, for either an important or non-important reason. The owner had either a surplus, or only one of the desired item(s). After each story read a statement, “It is acceptable/unacceptable for [borrower’s name] to use [owner’s name]’s [item]”. The two versions of this statement were counterbalanced across questions, as was whether the reason for borrowing (i.e., important or not), and whether the owner had a surplus. The same 7-point scale was used for participants to indicate their agreement with the statement. Across all questions, whether both characters were male or female was counterbalanced. The same order and wording of questions was used for all participants, and all participants received all 40 items. All questions, and instructions, are presented below:

Full Ownership Scale Used on Pilot Study Participants

Instructions.

Please read the stories below. At the end of each story is a statement, please circle a number from 1-7 to indicate your agreement with this statement. Although some stories might appear similar, please consider each story separately. There are no right or wrong responses so please just select the first response you think of.

Agreement scale



1. Eric is climbing on the rocks alongside the beach. He spots an oyster washed up on the shore. Eric peers through a small crack in the oyster. He sees a valuable pearl trapped inside, and wants it. To open the oyster, Eric throws it at a large rock, causing the shell to break. The valuable pearl flies into

the ocean. Frank is swimming by. He sees the pearl floating in the water and grabs it. Eric hurries over, and they begin to argue about who gets to keep it.

The pearl belongs to Frank: 1 2 3 4 5 6 7

2. Felicia needs a stereo to teach a free dance workshop for under-privileged youth. Her roommate Gabrielle, who is away on vacation, has two stereos. Felicia wants to take one of Gabrielle's stereos to the workshop, and then return it after.

It is acceptable for Felicia to use one of Gabrielle's stereos: 1 2 3 4 5 6 7

3. Jim lends Rob his ladder, so Rob can rescue a cat stuck in a tree. While Rob is trying to rescue the cat, Jim comes over and says he wants the ladder back immediately to clean out his eaves.

Rob should not keep the ladder till he is finished: 1 2 3 4 5 6 7

4. Todd is climbing on the rocks alongside the beach. He spots an oyster washed up on the shore. Todd tries to juggle the oyster and some rocks). The oyster is slimy, so it slips out of his hands and crashes onto a large rock. A valuable pearl, which was trapped inside the oyster, flies into the ocean. Todd sees the pearl and wants it. Aaron is swimming by. He sees the pearl floating in the water and grabs it. Todd hurries over, and they begin to argue about who gets to keep the pearl.

The pearl belongs to Todd: 1 2 3 4 5 6 7

5. Greg is on a hilltop, kicking his soccer ball around near a tree. He sees a nice pineapple up in the tree, and he wants it. Greg tries to kick the ball at the pineapple so that it will fall from the tree. However, a strong gust of wind sends the ball flying into the branch supporting the pineapple. The branch cracks and the pineapple drops to the ground. The pineapple rolls down the hillside. Henry is walking on a path at the bottom of the hill. He sees the pineapple lying on the ground and picks it up. Greg hurries over, and they begin to argue about who gets to keep it.

The pineapple belongs to Henry: 1 2 3 4 5 6 7

6. Nick needs an easel to paint a picture for his mother's upcoming birthday. His roommate Peter, who is out of town, has an easel. Nick plans to take Peter's easel, use it for the night, and then put it back.

It is acceptable for Nick to use Peter's easel: 1 2 3 4 5 6 7

7. Carly lets Deidra borrow her high quality tennis racket so that Deidra can practice her swing. In the middle of her practice, Carly shows up. She explains that she wants the racket back immediately, because she feels like playing tennis.

Deidra should keep the tennis racket till she is finished: 1 2 3 4 5 6 7

8. Stuart is taking a stroll in the desert. He walks by a cactus on top of a sand dune. Stuart stumbles on a rock. As he stumbles forward, he accidentally hits the cactus with his walking stick. The impact knocks free a beautiful feather that was trapped in the spines of the cactus. The feather starts to float down to the bottom of the dune. Stuart sees the feather and decides he wants it. Stan is walking along the bottom of the dune. He sees the beautiful feather on the ground and takes it. Stuart hurries over, and they begin to argue about who gets to keep it.

The feather belongs to Stuart: 1 2 3 4 5 6 7

9. Mike is on a hilltop, kicking his soccer ball around near a tree. He sees a nice pineapple up in the tree, and he wants it. Mike tries to kick the ball at a branch supporting the pineapple, so that it will fall from the tree. He hits the branch, it cracks, and the pineapple drops to the ground. The pineapple rolls down the hillside. Dave is walking on a path at the bottom of the hill. He sees the pineapple lying on the ground and picks it up. Mike hurries over, and they begin to argue about who gets to keep it.

The pineapple belongs to Mike: 1 2 3 4 5 6 7

10. Leah needs a pair of dress pants because she wants to look nice when she goes out with a friend. Her roommate Mary has several identical pairs, but she is out of town for a few days. Leah decides she will wear one pair of Mary's pants for the day, and then wash and return them.

It is acceptable for Leah to use a pair of Mary's pants: 1 2 3 4 5 6 7

11. John is taking a stroll in the desert. He walks by a cactus on top of a dune. John decides to hit the cactus using his walking stick. The impact knocks free a beautiful feather that was trapped in the spines of the cactus. The feather starts to float down to the bottom of the dune. John sees the feather and decides he wants it. William is walking along the bottom of the dune. He sees the beautiful feather on the ground and takes it. John hurries over, and they begin to argue about who gets to keep it.

The feather belongs to William: 1 2 3 4 5 6 7

12. Andy lets Brad borrow his chemistry textbook, because Brad wants to learn more about chemistry. While Brad is reading the book, Andy comes over and says he wants it back immediately because he feels like reading it.

Brad should keep the book till he is finished: 1 2 3 4 5 6 7

13. Anna lets Britney borrow her toolset so that Britney can work on a shop project due tomorrow. While Britney is working on the project, Kathryn comes over and says she wants the toolset immediately to make a picture frame.

Andrea should not keep the toolset till she is finished: 1 2 3 4 5 6 7

14. Michelle needs a pair of dress pants because she wants to look nice when she goes out with a friend. Her roommate Veronica has a pair of dress pants, but she is out of town for a few days. Michelle decides she will wear Veronica's pants for the day, and then she will wash and return them.

It is acceptable for Michelle to use Veronica's pants: 1 2 3 4 5 6 7

15. Allen is out paddling his rowboat in the bay. He sees a rocky sandbar. Using one of his paddles, Tom hits some of the rocks at the base of the sandbar. The rocks tumble into the water, carrying with them a beautiful shell. Allen sees the shell and decides he wants it. Brian is swimming by the sandbar. He sees the shell floating in the water and grabs it. Allen hurries over, and they begin to argue about who gets to keep it.

The shell belongs to Allen: 1 2 3 4 5 6 7

16. Chris is taking a stroll in the desert. He walks by a cactus on top of a dune. He sees a beautiful feather trapped in the spines of the cactus, and he wants the feather. Using his walking stick, Chris tries to hit the cactus, so that the feather will be knocked free from the spines. He hits the cactus, and the feather is knocked free by the impact. The feather floats down to the bottom of the dune. Dave is walking along the bottom of the dune. He sees the beautiful feather on the ground and takes it. Chris hurries over, and they begin to argue about who gets to keep it.

The feather belongs to Dave: 1 2 3 4 5 6 7

17. Nadine needs a stereo to teach a free dance workshop for under-privileged youth. Her roommate Olivia, who is away on vacation, has a stereo. Nadine plans to take Olivia's stereo to the workshop, and then return it after.

It is unacceptable for Nadine to use Olivia's stereo: 1 2 3 4 5 6 7

18. George needs a saw to make a shelf. His neighbor Jeff, who is out of town right now, keeps several saws in an unlocked shed in his backyard. George plans to take one of Jeff's saws, use it, and then return it.

It is acceptable for George to use one of Jeff's saws: 1 2 3 4 5 6 7

19. Ethan needs an easel to paint a picture his mother has been hoping for, for her upcoming birthday. His roommate Fred, who is out of town, has two easels. Ethan wants to take one of Fred's easels, use it for the night, and then put it back.

It is unacceptable for Ethan to use one of Fred's easels: 1 2 3 4 5 6 7

20. Kathryn lets Andrea borrow her high quality tennis racket, so that Kathryn can play in an important tournament. In the middle of the final match, Kathryn shows up and explains that she wants the racket back immediately to play tennis.

Andrea should not keep the tennis racket till she is finished: 1 2 3 4 5 6 7

21. Quinn needs a saw to make a shelf. His neighbor Ralph, who is out of town right now, keeps a saw in an unlocked shed in his backyard. Quinn wants to take Ralph's saw, use it, and then return it.

It is unacceptable for Quinn to use Ralph's saw: 1 2 3 4 5 6 7

22. Johnny is on a hilltop, kicking his soccer ball around near a pineapple tree. Johnny kicks the ball at one of the tree's branches as hard as he can. The branch cracks, knocking a pineapple to the ground. The pineapple starts rolling down the hillside. Johnny sees the pineapple and wants it. Mark is walking on a path at the bottom of the hill. He sees the pineapple lying on the ground and picks it up. Johnny hurries over, and they begin to argue about who gets to keep it.

The pineapple belongs to Mark: 1 2 3 4 5 6 7

23. Sean is out paddling his rowboat in the bay. He sees a rocky sandbar. One of Sean's paddles accidentally hits some of the rocks at the base of the sandbar. The rocks tumble into the water, carrying with them a beautiful shell. Sean sees the shell and decides he wants it. Steven is swimming by the sandbar. He sees the shell floating in the water and grabs it. Sean hurries over, and they begin to argue about who gets to keep it.

The shell belongs to Steven: 1 2 3 4 5 6 7

24. Doug needs an easel to practice his painting skills. His roommate Spencer, who is out of town, has an easel. Doug plans to take Spencer's easel, use it for the night, and then put it back.

It is unacceptable for Doug to do this: 1 2 3 4 5 6 7

25. Cameron is taking a stroll in the desert. He walks by a cactus on top of a dune. He sees a beautiful feather trapped in the spines of the cactus, and he wants the feather. Using his walking stick, Cameron tries to knock the feather free from the spines. He accidentally hits the base of the cactus. The feather is knocked free by the impact. The feather floats down to the bottom of the dune. Kyle is walking along the bottom of the dune. He sees the beautiful feather on the ground and takes it. Cameron hurries over, and they begin to argue about who gets to keep it.

The feather belongs to Cameron: 1 2 3 4 5 6 7

26. Julia needs a stereo for a party she is hosting at work. Her roommate Katie, who is away on vacation, has two stereos. Julia plans to take one of Katie's stereos to her work place and then return it after.

It is unacceptable for Julia to use Katie's stereo: 1 2 3 4 5 6 7

27. Paula needs a pair of dress pants for an important work meeting, where she is the speaker. Her roommate Rachel has a pair of dress pants, but she is out of town for a few days. Paula decides she will wear Rachel's pants for the day, and then wash and return them.

It is unacceptable for Paula to use Rachel's pants: 1 2 3 4 5 6 7

28. Tom is out paddling his rowboat in the bay. He sees a beautiful shell high on top of a rocky sandbar and he decides he wants it. Using one of his paddles, Tom tries to hit some of the rocks at the base of the sandbar, so that the shell will fall into the water. He hits the rocks and they tumble into the water, carrying with them the beautiful shell. Paul is swimming by the sandbar. He sees the shell floating in the water and grabs it. Tom hurries over, and they begin to argue about who gets to keep it.

The shell belongs to Paul: 1 2 3 4 5 6 7

29. Liam is climbing on the rocks alongside the beach. He spots an oyster washed up on the shore. Liam peers through a small crack in the oyster. He sees a valuable pearl trapped inside, and wants it. Liam tries to open the oyster. The oyster is slimy, however, and it slips out of his hands and goes flying into a large rock. The shell breaks and the valuable pearl flies into the ocean. Myles is swimming by. He sees the pearl floating in the water and grabs it. Liam hurries over, and they begin to argue about who gets to keep it.

The pearl belongs to Liam: 1 2 3 4 5 6 7

30. Jordan lends Mark his ladder, so Mark can climb up into a very tall tree. While Mark is using the ladder, Jordan comes over. He says he wants the ladder back immediately because he feels like cleaning out his eaves.

Mark should not keep the ladder till he is finished: 1 2 3 4 5 6 7

31. Sandy needs a stereo for a party she's hosting at work. Her roommate Tara, who is away on vacation, has a stereo system. Sandy plans to take Tara's stereo system to her work place, and then return it after.

It is acceptable for Sandy to borrow Tara's stereo system: 1 2 3 4 5 6 7

32. Neil is on a hilltop, kicking his soccer ball around near a pineapple tree. Neil tries to kick the ball as high as he can. A strong gust of wind sends the ball flying into the tree. The ball hits a branch supporting a pineapple. The branch cracks and the pineapple drops to the ground. The pineapple starts rolling down the hillside. Neil sees the pineapple and wants it. Randy is walking on a path at the bottom of the hill. He sees the pineapple lying on the ground and picks it up. Neil hurries over, and they begin to argue about who gets to keep it.

The pineapple belongs to Neil: 1 2 3 4 5 6

33. Elizabeth lets Ally borrow her toolset, so Ally can fix up some things around her house. When Ally is almost done, Elizabeth comes over. She says she wants the toolset immediately so she can make a picture frame.

Ally should keep the toolset till she is finished: 1 2 3 4 5 6 7

34. Jerry lets Roger borrow his chemistry textbook, because Roger needs it to study for a test. While Roger is reading the book, Jerry comes over and says he wants it back immediately because he feels like reading it.

Roger should not keep the book till he is finished: 1 2 3 4 5 6 7

35. Ben is climbing on the rocks alongside the beach. He spots an oyster washed up on the shore. Ben wants to practice his aim, so he throws the oyster at a large rock. The oyster hits the rock, causing the shell to break. A valuable pearl, which was trapped inside the oyster, flies into the ocean. Ben sees the pearl and wants it. Kevin is swimming by. He sees the pearl floating in the water and grabs it. Ben hurries over, and they begin to argue about who gets to keep it.

The pearl belongs to Kevin: 1 2 3 4 5 6 7

36. Holly needs a pair of dress pants for an important work meeting, where she is the speaker. Her roommate Isabelle has several identical pairs, but she is out of town for a few days. Holly plans to wear one pair of Isabelle's pants for the day, and then wash and return them.

It is unacceptable for Holly to use a pair of Isabelle's pants: 1 2 3 4 5 6 7

37. Ken needs an easel to practice his painting skills. His roommate Lucas, who is out of town, has two easels. Ken takes one of Lucas' easels, uses it for the night, and then puts it back.

It is acceptable for Ken to use one of Lucas' easels: 1 2 3 4 5 6 7

38. Calvin needs a saw to free his dog, who is stuck beneath a fallen tree. His neighbor Dan, who is out of town right now, keeps several saws in an unlocked shed in his backyard. Calvin wants to take one of Dan's saws, use it, and then return it.

It is acceptable for Calvin to use Dan's saw: 1 2 3 4 5 6 7

39. Isaac is out paddling his rowboat in the bay. He sees a beautiful shell high on top of a rocky sandbar, and decides he wants it. Using one of his paddles, Isaac tries to knock the shell into the water. He misses and instead hits some of the rocks at the base of the sandbar. The rocks tumble into the water, carrying with them the beautiful shell. James is swimming by the sandbar. He sees the shell floating in the water and grabs it. Isaac hurries over, and they begin to argue about who gets to keep it.

The shell belongs to Isaac: 1 2 3 4 5 6 7

40. Michael needs a saw to free his dog, who is stuck beneath a fallen tree. His neighbor Joseph, who is out of town right now, keeps a saw in an unlocked shed in his backyard. Michael plans to take Joseph's saw, use it, and then return it.

It is unacceptable for Michael to use Joseph's saw: 1 2 3 4 5 6 7

Note. The stories in standard typeface were deleted. These are the original items used for all analyses. The pineapple stories were changed such that a coconut, rather than pineapple, is the object of interest (questions 5, 9, 22, and 32).

Results

Analyses were based on the ratings for each of the 40 items in the scale. Participants' data were omitted if there were missing scores, and half of the items were reverse-coded prior to analyses. A Cronbach's alpha was obtained to measure the internal consistency of the full 40 items, yielding a value of .837. Alpha values above .8 are generally considered acceptable, so this result indicated high interrelation between items.

An initial exploratory factor analysis (EFA) was conducted on the basis of our three story types: (a) deciding ownership (new ownership), and for discovering ownership in instances of (b) borrowing with permission, and (c) borrowing without permission. Both Oblimin and Varimax rotations were initially carried out, and in both analyses the factors were not correlated.

Accordingly, the Varimax rotation was decided upon as the better option, as it is intended for use on independent factors.

The three factors extracted from the EFA revealed that Factor 1 contained the highest loadings from borrowing without permission, however the borrowing with permission category also had loadings greater than .40 for this factor. The highest loadings for Factors 2 and 3 were all from the deciding ownership conditions; some of these items loaded more highly onto Factor 2 while others loaded highly onto Factor 3. Our intention was to eventually shorten the scale by about half, so an exclusion criterion was assumed such that items with factor loadings below .4 were deleted. All stories regarding a specific object were removed if any of one those stories met the exclusion criteria. This avoided the problem of leaving an incomplete set of variants for any base story³. Thirty-two items remained, which was far from half of the original 40.

The factor analysis revealed that the borrowing with permission items had mostly negative factor loadings that exceeded the inclusion criterion of .4 (with only two loadings in the positive direction, for factor 1). The pattern of loadings for these questions was not easily discernable, and made little sense compared to the dispersal of loadings from items in the other categories. This can be attributed to a mistake in planning the story categories. The borrowing with permission category only contained six items, whereas the other two categories had either 16 (category [a]) or 17 (category [c]) items. As a result, and with the goal of brevity in mind, the borrowing with permission category was eliminated. Additionally, a more strict inclusion criterion was instated, leaving only those items with factor loadings greater than .5. Again, any

³ Each object was used in only one category, with the specified variations. Thus, eliminations based on the exclusion criteria alone (factor loadings at or below .4) left an incomplete array of variations, which would interfere with proper analyses.

leftover variants were also deleted. This reduced the number of items to 24. For all factor loadings belonging to the original 40 items, see Table 1.

The three-factor structure was not easily explained by the two remaining categories: (a) deciding ownership, and (b) borrowing without permission; these can now be more simply referred to as (a) deciding ownership, and (b) discovering ownership. Upon closer inspection, it was evident that (b) was interspersed between Factors 2 and 3 such that Factor 3 had only the reverse-coded items, with the remaining items loading highly onto Factor 2. This might have been due to an acquiescence response set. In any case, we decided to do another EFA for two factors, with the hypothesis that Factor 2 would comprise the 12 discovering ownership stories. Factor 1 was unchanged, containing each of the deciding ownership stories. Factor 2 successfully collapsed across the former Factors 2 and 3 to include each of the discovering ownership stories. Together, the factors account for 50.04 % of the variance in answers (30.38 % and 19.66 % for Factors 1 and 2, respectively). Fortunately, Factors 1 and 2 contained exactly 12 stories each (see Table 2 for final items and their loadings on Factors 1 and 2).

After deciding upon the two-factor structure, the internal consistency was calculated for both factors. A Cronbach's alpha of .942 was obtained for Factor 1, and .852 for Factor 2. Both of these values pass the generally accepted alpha of .8, and are thus considered to reflect high internal consistency.

Table 1

Factor Loadings with Varimax Rotation: 40 Items on 3 Factors

Scale	Factor 1	Factor 2	Factor 3
a) Deciding Ownership			
Q1		.724	
Q4			.460
Q5		.701	.191
Q8		.115	.679
Q9		.338	.626
Q11		.709	.142
Q15		.268	.639
Q16	-.117	.706	
Q22		.575	
Q23		.612	.158
Q25		.352	.672
Q28		.745	
Q29		.418	.605
Q32		.115	.732
Q35		.576	.172
Q39		.379	.664
b) Discovering Ownership (without perm.)			
Q2	.838		-.170
Q6	.788	.167	-.218
Q10	.718	.273	-.225
Q14	.657	.367	-.251
Q17	.785	-.250	.103
Q18	.587	.175	-.415
Q19	.710	-.197	.128
Q21	.658		
Q24	.808	-.137	.138
Q26	.769	-.108	
Q27	.762		.122
Q31	.706	.352	-.230
Q36	.778	-.126	.126
Q37	.791	.204	-.191
Q38	.411		-.140
Q40	.340	-.389	
c) Discovering Ownership (with perm.)			
Q3	.314	-.414	
Q7	.285	.192	-.410
Q12	.206	.216	-.405
Q13	.239	-.138	.273
Q20	.397	-.407	.115
Q30	.212	-.226	
Q33	.430		-.337
Q34	.451	-.374	

note. Factor loadings >.50 are in boldface. In the (b) and (c) scales, permission is shortened to perm.

Table 2

Factor Loadings with Varimax Rotation: 40 Items on 3 Factors

Scale	Factor 1	Factor 2	Factor 3
a) Deciding Ownership			
Q1		.724	
Q4			.460
Q5		.701	.191
Q8		.115	.679
Q9		.338	.626
Q11		.709	.142
Q15		.268	.639
Q16	-.117	.706	
Q22		.575	
Q23		.612	.158
Q25		.352	.672
Q28		.745	
Q29		.418	.605
Q32		.115	.732
Q35		.576	.172
Q39		.379	.664
b) Discovering Ownership (without perm.)			
Q2	.838		-.170
Q6	.788	.167	-.218
Q10	.718	.273	-.225
Q14	.657	.367	-.251
Q17	.785	-.250	.103
Q18	.587	.175	-.415
Q19	.710	-.197	.128
Q21	.658		
Q24	.808	-.137	.138
Q26	.769	-.108	
Q27	.762		.122
Q31	.706	.352	-.230
Q36	.778	-.126	.126
Q37	.791	.204	-.191
Q38	.411		-.140
Q40	.340	-.389	
c) Discovering Ownership (with perm.)			
Q3	.314	-.414	
Q7	.285	.192	-.410
Q12	.206	.216	-.405
Q13	.239	-.138	.273
Q20	.397	-.407	.115
Q30	.212	-.226	
Q33	.430		-.337
Q34	.451	-.374	

note. Factor loadings $>.50$ are in boldface. In the (b) and (c) scales, permission is shortened to perm.

Discussion

The internal reliability is high across the full scale, and across the two extracted factors. An effect of high correlation among items is that, when studied with twins, much of the variance in ratings can be explained by genetics and common environment. The genetic contribution to a phenotype (e.g., ownership reasoning) is identical for MZ twins. Thus, differences in reasoning (i.e., different ratings) between MZ twins are entirely attributable to non-shared environment. If a survey were unreliable however, the source of variation would be misinterpreted as non-shared environment, when it is in fact due to error. The high Cronbach's alpha obtained in our study ensures that the contribution from non-shared environment (and error) is reduced. Consequently, responses can be attributed to genetics and shared environment.

The final two-factor analysis provides evidence of survey validity. As theory predicted, ratings for the deciding ownership stories were highly correlated with each other (Factor 1), as were the discovering ownership stories (Factor 2); the parallel between theory and data enhances the construct validity of the survey. The two factors also increase the content validity of the survey by providing a more representative sample of ownership reasoning (i.e., more than just one dimension).

As described in the introduction, MZ and DZ twin data can be used to parcel out genetic from environmental influences. Before this study, the experiments on ownership reasoning generally used only a few questions. In addition, the questions were generally followed by only two response options, reducing the possible variation per item score⁴. By including more items, more responses, and by representing more than one dimension of ownership inferences (i.e., deciding and discovering contexts), the survey in the present study aims to develop a more

⁴ Palamer et al. 2012 used a confidence rating from 0-10 in addition to selection of either the pursuer or possessor.

reliable and representative scale. The introduction of 7-point agreement scales also allows for precise analyses of variation in ownership reasoning. Considering these points, we hope to send out the revised survey to around 100 pairs each of MZ and DZ twins in order to determine the variation attributable to an innate basis.

In the future, other dimensions of ownership reasoning can be investigated to determine their genetic and environmental bases. Possible dimensions include both those related to the question of who owns what, as well as those related to other questions entirely. For instance, examples belonging to the former category are: (a) borrowing with permission (excluded in the final scale), (b) borrowing items from family versus non-family members (evolutionary predictions), and (c) theft for altruistic or selfish reasons. In relation to different questions entirely, examples include: (a) what rights are incurred by ownership, (b) whether the rights incurred differ according to personal characteristics (e.g., of the owner), and whether reasoning (c) develops over time, and/or (d) is different across different cohorts. These are just some examples of the many domains to be examined. It should be kept in mind that each of these dimensions is likely interrelated with the others. Even in the present survey, the question of who owns what is largely confounded with the rights and privileges of ownership for the borrowing stories. In any case, expanding the situations that are covered by analyses can lead to more specific and qualified conclusions regarding the bases of ownership concepts.

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