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'Bat, Bird, Cow': A Comparative Analysis of Categorisation Abilities in an Autistic, and a Typically Developing Child.

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Introduction

Categorisation is a crucial element of cognition, enabling us to perceive, discuss and recall our surroundings (Smith & Medin 1981). Although it is well documented that autistic individuals have trouble applying previously learned information and rules to novel situations, which can negatively impact their quality of life (Klinger & Dawson 1995), agreement is yet to be reached as to whether these difficulties are caused by a specific impairment in categorisation, which could account for some of the social, behavioural and communicative difficulties which are associated with autism.

The most widely accepted categorisation theory is the prototypical approach, which suggests that category members vary in the amount of features and properties that they share, and therefore also vary in their strength of representing a particular concept (Rosch 1973; Rosch & Mervis 1975; Smith & Medin 1981). Members which have the highest 'family resemblance', that is, the most mutual attributes with fellow category members and the least mutual attributes with other categories are considered the most 'prototypical', meaning they are 'good', 'representative' members of their category, easier to learn, and quicker to label (Rosch 1973). Furthermore, our categories may additionally be labelled as 'basic level', for which concrete mental images for the category as a whole may most easily be formed (Rosch, Mervis, Gray, Johnson & Boyes-Braem 1976), 'subordinate', and 'superordinate'. Similarly, category membership can be verified for basic levels most rapidly, suggesting that they have the greatest cognitive primacy (*ibid*). Children usually acquire basic level terms first and use them more, while it appears that subordinate categories are last to be acquired (Mervis 1983). Typicality also informs children's acquisitions, as when presented with various category members, young children (aged 3-5) learn prototypical exemplars first (Mervis & Pani 1980).

Since prototypical theories appeared, various studies have examined the relationship between autism and categorisation, with mixed results. Tager-Flusberg (1985) found that both autistic and typically developing children were equally able to categorise at basic level, with both making more errors for peripheral members. The autistic children were even higher performers in various categories in a superordinate level task. Although this appears to indicate that autistic children have intact categorisation, the autistic children, whose mean chronological age was 10 years 5 months, were matched to the control group based on verbal mental age, rather than chronological age or non-verbally assessed mental age, which presents an unfair test as any age-based developmental delays in categorisation abilities cannot be seen. Verbal mental age is also unrepresentative of the autistic children's cognitive abilities as autistic individuals are known to display higher levels of cognition than their verbal output would suggest (Schopler & Mesibov 1995). Each child also had to perform 6 consecutive trials correctly before accessing the test stimuli, meaning that the children undoubtedly received varying levels of training, again highlighting a lack of control. The 'peripheral' stimuli, such as 'mushroom' for the 'vegetable' category, were also arguably not the most peripheral options available, so clearer differences may have been seen with more challenging stimuli.

Klinger and Dawson (1995) found that both typically developing and autistic children were equally successful in categorisation using rule-based strategies, but in prototype based categorisation, when no single feature or combination of features could clearly determine category membership, the typically developing children performed significantly better, suggesting that autistic children can successfully categorise using concrete rules, but struggle to form prototypical mental representations. Problematically, control matching was again based on verbal mental age, while chronological ages were undisclosed.

In a category verification task examining high-functioning autistic children (aged 9-12), adolescents (aged 13-16), and adults (aged 17-48), against controls matched on a combination of factors including chronological age and full scale intelligence testing, Gastgeb, Strauss and Minshew (2006) found that although typicality effects on accuracy were similar for all, with more typical stimuli prompting the highest accuracy rates, autistic children were significantly slower to respond than control children. Typicality also affected their reaction times more, as they responded significantly slower to 'somewhat typical' category members than control children, an effect which was even more dramatic for atypical stimuli. Encouragingly, the reaction times of both autistic adolescents and adults to

'somewhat typical' stimuli were similar to their control group, suggesting that experienced autistic individuals learn to categorise fairly typical category members as efficiently as their typically developed peers. However, they still found atypical stimuli problematic.

Gastgeb, Dundas, Minshew and Strauss (2012) found that high-functioning autistic adults had difficulty forming prototypes and categories from dot patterns, with only half successfully endorsing the prototypical pattern in every trial, versus 84% of typically developed adults. The use of dot patterns is particularly insightful, as it prevents prior knowledge or experience affecting results, which must therefore only reflect prototype and category formation. Using similar methodology, Froehlich et al (2012) found that high-functioning autistic adults demonstrated intact prototype formation, although accuracy rates became significantly lower than the typically developed control group as patterns became moderately or highly distorted.

Church et al (2010) found that high-functioning autistic children (aged 7-12) were less likely than their typically developing control group to use typicality when forming categories or making categorical decisions. The autistic children endorsed the prototype significantly less, and unrelated stimuli significantly more, than their control group, with only 55% of autistic participants showing any sensitivity to the distance of the stimuli from the prototype, compared to 95% of the typically developing children, suggesting that they were not successfully using family resemblance to categorise. This was supposedly due to autistic individuals having 'hyper-specific representations', which are so detailed and event-specific that they cause difficulties in learning perceptual categories which require complex generalisation and transferring learning to novel stimuli. Molesworth, Bowler and Hampton (2008), contrasted these results, as two thirds of children studied (aged 9-15), with high-functioning autism or Asperger's syndrome showed typicality effects identical to their control group. However, as the conditions are in-fact separate, the results may have differed if the groups had been separated accordingly.

Overall, it appears that autism may affect categorisation, but the extent of this is unclear, and it is not yet fully understood whether this is due to a specific categorisation impairment, or other issues related to the disorder. My own study aims to further understand this issue by comparing an autistic child's performance with a control participant in various categorisation tasks, predicting that the autistic child's responses may be less accurate, and slower, than that of the control child.

The Study

a) Methodology:

The tasks were performed individually in a quiet room without interruptions. The children had no prior training to provide more natural results. All audio was recorded electronically (*Appendix A*), as were decision-making times, for Part 2 of the task.

The experiment involved 2 categorisation tasks, with each using a simple trial question to ensure that the children understood the instructions. Part 1 elicited prototypes by asking the children to name as many different types of a superordinate category as possible, within a minute. The categories were 'drinks', 'toys', 'pets' and 'games'. Part 2 was a category verification task, where the children had to judge whether stimuli, presented visually and verbally, belonged to a certain concept. The concepts presented were 'pets', and 'toys'. Each concept used 10 images, of which 4 were non-members, and 6 were members of the category, although some stimuli, such as 'hedgehog' for the 'pet' category, were deliberately peripheral, while others, such as 'dog', were deliberately prototypical (*Appendix B*). Decision times were also recorded here. An additional task which elicited basic level representations from the children was also performed, though its results are not included due to the restrictions of this project (See *Appendix C and D* for the stimuli and results).

For typicality to be examined, data was collected from an online survey of 18 participants, who were asked to rate the typicality of 6 examples of the superordinate categories 'pets' and 'toys', which were used both tasks (See *Appendix E* and *F* for the survey and results). The typicality scores are below:

Table 1: Typicality of pets:

Pets *(Ranked from High to Low for Prototypicality):*	Typicality Score (1-6)
Dog	5.56
Cat	4.71
Rabbit	4.24
Rat	2.56
Snake	2.06
Hedgehog	2.06

Table 2: Typicality of toys:

Toys *(Ranked from High to Low for Prototypicality)*:	Typicality Score (1-6)
Lego/building blocks	5.33
Radio/remote controlled car	4.22
Play-doh/modelling clay	3.78
Doll	3.17
Teddy bear	3.00
Stickers	1.33

The study was also piloted on a control adult under the same conditions. During Part 2 of the pilot, I read the question on screen in full for each question, such as 'Is a dinosaur a type of pet?' However, this meant that recorded decision times were inaccurate as the question took a significant amount of time to read. In the test trials, I instead named the item as the image appeared, so that decision times could be measured more accurately. Where useful, the adult's responses have been presented alongside the children's for comparison.

b) Participants

The participants were two British monolingual boys aged 5 years, 3 months, and 4 years, 10 months, who were matched on chronological, rather than mental age. Both are in reception at state-run mainstream schools.

David[1] has recently been diagnosed with Autism Spectrum Disorder (for a detailed report, see *Appendix G*). He displays significant impairments in communication and social interaction. His speech was delayed, and is now impaired, while he does not frequently engage in spontaneous conversation. However, he shows above average cognitive ability in certain areas, such as mathematics.

Ben, the control participant, is a typically developing child from a similar socioeconomic background and geographical area to David. There are no concerns with his academic abilities and there is no known history of Autism Spectrum Disorder in his family.

The pilot adult is David's mother. She is a typically developed, monolingual, British adult, and other than David, there is no known history of Autism Spectrum Disorder in her family.

c) Analysis

Part 1

[1] Pseudonyms have been used for both children to protect anonymity.

Table 3: Results from 'Drinks' Recall Task:

Drinks named in 1 minute:	David	Ben	Adult Pilot
1	Juice	Coca Cola	Water
2	Mevud [inaudible]	Water	Prosecco
3	Water	Juice	Tea
4	Apple juice	Smoothie	Coffee
5	Milk	Carton	Milk
6	Chocolate milkshake	Apple juice	Milkshake
7	Strawberry milkshake		Hot chocolate
8	Banana milkshake		Cappuccino
9			Latte
10			Beer
11			Vodka
12			Cider
13			Gin
14			Babycino
15			Coke
16			Tango
17			Fanta
18			Appletise [r]
19			Shloer
20			Flavoured water
21			Fizzy water
22			Redbull
23			Energy drink
24			Red wine
25			White wine
26			Babysham
27			Martini
28			Orange juice
29			Apple juice

All 3 participants mentioned 'water' very early, highlighting its universal prototypicality. While neither child recalled as many representations as the adult, David's exemplars were more detailed than Ben's, separating 'milkshake' into 3 categories based on flavour, compared to the more general 'smoothie' and 'carton' categories, from Ben. David also used an unclear nonce word which did not appear to be linked to the category.

Table 4: Results from 'Toy' Recall Task:

Toys named in 1 minute:	David	Ben	Adult Pilot
1	Cow	Cars	Sex toys
2	Cards	Lego	Children's toys
3	Choo Choo Train	Transformers	Lego
4		Digger sets	Star Wars toys
5		Lightsabers	Dolls
6		A garage	Cars
7		Telescope	Trucks
8			Vans
9			Buses
10			Dolls' Houses
11			Toy vacuum cleaners
12			Toy washing machines
13			Building toys
14			Play-doh
15			Paints
16			Glitter
17			Glue
18			Colouring books
19			Playhouses
20			Wendy houses
21			Bows and arrows

These results may be linked to the typicality scores in *Table 1.* Ben's first examples were the most prototypical toys in the online survey, and these toys were also mentioned fairly quickly by the adult. David did not recall these exemplars, despite being familiar with them. It was unclear whether he was referring to a toy 'cow', or miscategorising a living 'cow' as a toy. Both the adult and Ben's recalls were affected by current events as seen in 'Star Wars toys', from the adult, and 'lightsabers', from Ben. David's exemplars showed no such influence.

Table 5: Results from 'Pet' Recall Task:

Pets named in 1 minute:	David	Ben	Adult Pilot
1	Rabbit	Cats	Dog
2	Cat	Dogs	Cat
3	Dog	Hamsters	Lizard
4	Bat		Snake
5	Bird		Rabbit
6	Cow		Guinea pig
7			Mouse
8			Hamster
9			Rat
10			Stick insects
11			Ferret
12			Goldfish
13			Anything reptilian

For this category, all participants quickly recalled prototypical exemplars as shown in *Table 2.* David was very successful here, recalling the 3 highest scorers immediately. Whereas Ben stopped attempting recollections after his initial correct recalls, David named animals which are not kept as pets, such as 'bat' and 'cow', which he also mentioned in the 'toy' category.

Table 6: Results from 'Games' Recall Task:

Games named in 1 minute:	David	Ben	Adult Pilot
1	Inside Out bubbles	Dice racer	Sex games
2	Numbers	Phone holiday	Board games
3	Ye-ha	South West [unclear] game	Computer games
4		Motorways	Snakes and ladders
5			Cluedo
6			Ludo
7			Frustration
8			Kerplunk
9			Monopoly
10			Chess
11			Backgammon
12			Cards
13			Guess Who
14			Connect 4
15			Tennis
16			Hide and seek
17			Lurkey
18			Football
19			Baseball
20			Cricket
21			Rounders
22			Badminton

As in all the categories in this task, neither child displayed adult-like responses. Both children particularly struggled with this category and named games which neither family of the individual are familiar with, such as 'Yee-ha', and 'Phone holiday'. These games may have been learned away from the family home, or may be nonce examples, created by the children.

Part 2:

Table 7: Results from Pet Category Verification Task

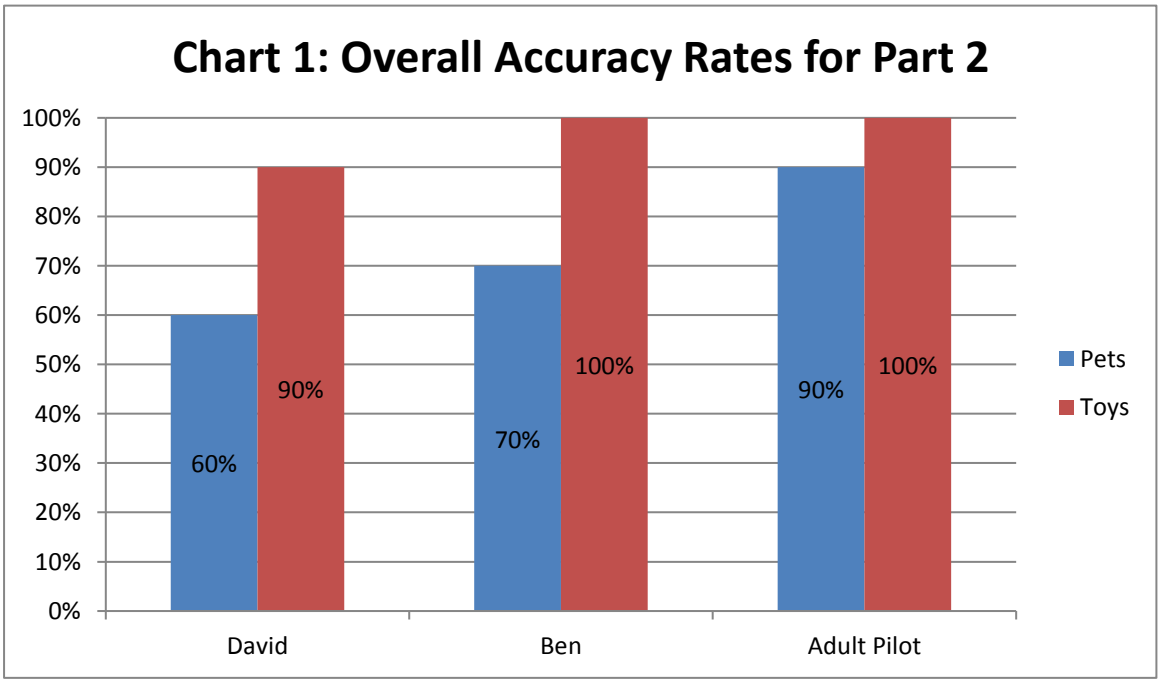
Pet Category Response to item and decision time (to the nearest millisecond):	David	Ben	Adult Pilot *Decision times not comparable due to methodological differences outlined previously.
1. Dinosaur	No	No…Yeah…No	No
	01:47	03:31	Less than 1 second*
2. Dog	Yes	Yeah	Yes
	02:86	00:52	Less than 1 second*
3. Rabbit	Yeah…No…Rabbit… (after probing)…No	Ye…No	Yes
	13:01	01:40	Less than 1 second*
4. Tree	No	No	No
	01:79	00:43	Less than 1 second*
5. Snake	Er…No	No	Yes
	02:23	00:89	Less than 1 second*
6. Cat	Yeah	Yes	Yes
	01:23	00:90	Less than 1 second*
7. Hedgehog	No	No	No
	01:79	00:93	Less than 1 second*
8. Box	No	No	No
	00:81	00:92	Less than 1 second*
9. Rat	No	No…Yeah	Yes
	01:15	01:66	Less than 1 second*
10. Lion	No	No	No
	01:15	00:84	Less than 1 second*

Neither child displayed adult-like verification, although the differences between the children and the adult were more subtle in this task than in Part 1. Overall, Ben's verification was more accurate than David's, and his decision making was 1.57 seconds faster than David's, on average. Interestingly, both children struggled to judge 'rabbit', and decided that it was not a member of the 'pet' category, despite it having a high typicality score, and being David's first example of a pet in Part 1.

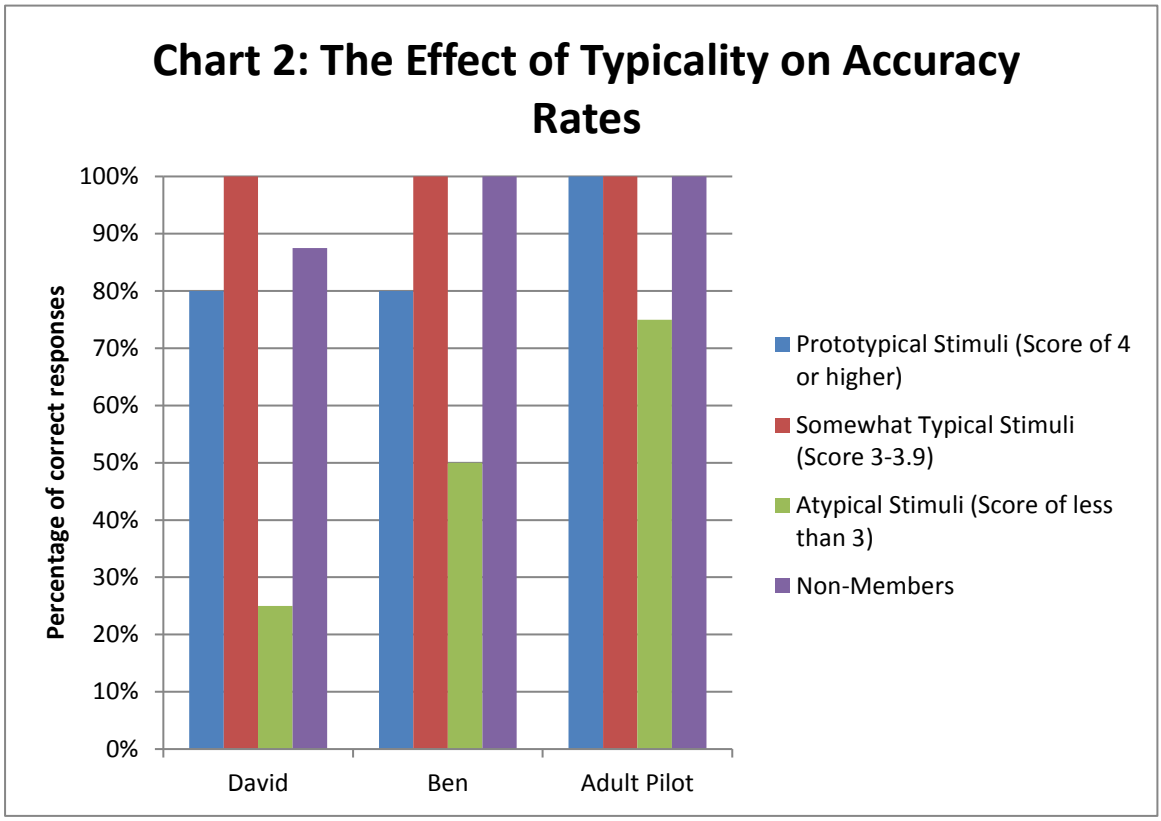
Table 8: Results from Toy Verification Task:

Toy Category Response to item and decision time (to the nearest millisecond):	David	Ben	Adult Pilot *Decision times not comparable due to methodological differences outlined previously.
1. Doll	Er…yeah	Yeah	Yes
	02:99	01:28	Less than 1 second*
2. Remote controlled car	Yeah	Yeah	Yes
	01:18	00:78	Less than 1 second*
3. Shampoo	Er…No	No	No
	01:56	01:07	Less than 1 second*
4. Pencil case	Er…Yeah	No	No
	02:09	01:24	Less than 1 second*
5. Building blocks	Yes	Yeah	Yes
	00:83	00:89	Less than 1 second*
6. Stickers	Yes	No…Yeah	Yes
	00:88	01:43	Less than 1 second*
7. Toilet	No	No	No
	00:43	01:07	Less than 1 second*
8. Modelling clay	Yeah	Yeah	Yes
	01:14	00:93	Less than 1 second*
9. Teddy bear	Yeah	Ye…Yeah	Yes
	01:31	01:72	Less than 1 second*
10. Nightlight	Er…Nope	No	Hmm…Not really
	02:49	01:75	1-2 seconds*

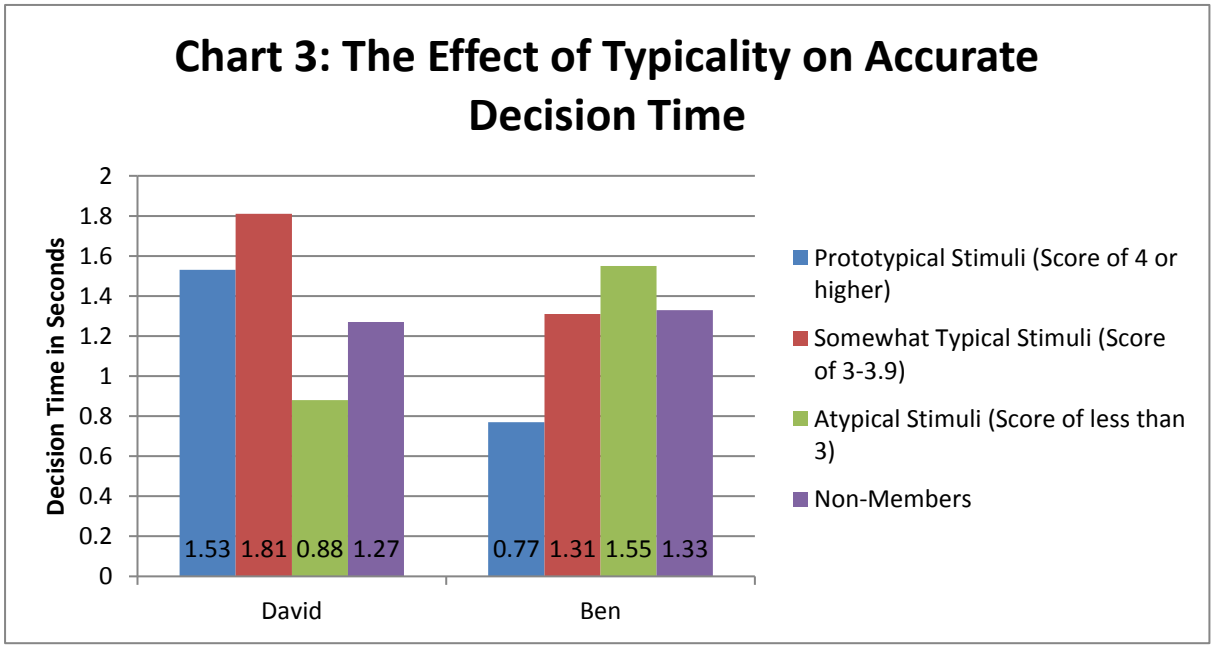
Both children were more successful in this category, although Ben was still more accurate than David, and made his decisions an average of 0.27 seconds faster than David. Both took longer to judge non-members which bore some resemblance to the category (such as pencil case, which David falsely verified as a toy, and nightlight), compared to non-members with less resemblance (such as shampoo and toilet).



As the chart highlights, Ben's accuracy was higher than David's throughout, though the difference was smaller for the 'toy' category. It is also worth noting that the only 'inaccurate' response from the adult was for 'hedgehog', which is an extremely peripheral category member.



All participants had the greatest difficulty correctly judging atypical stimuli, for which David had the poorest accuracy rates, making correct judgements only half as often as Ben. Unexpectedly, both children were more successful with somewhat typical stimuli than prototypical stimuli, which is due to their misjudgement of 'rabbit' as a non-member.



Ben clearly showed the expected results of slower judgement times as the stimuli became less typical. While David was quicker to accurately judge prototypical stimuli than somewhat typical stimuli, his fastest accurate verification was for atypical stimuli (stickers). However, as this was his only correct verification for the 'atypical' category, it may not be representative. Decision times to accurately discard non-members were similar for both children.

Discussion & Conclusion

In line with many of the studies outlined previously (Klinger & Dawson 1995; Gastgeb et al 2006; 2012; Church et al 2010; Froehlich et al 2012), my results signify a correlation between categorisation abilities and autism, and contrast studies suggesting that autistic individuals may not have impaired categorisation capabilities (Tager-Flusberg 1985; Molesworth et al 2008).

In Part 1, the children were generally able to recall similar amounts of category members. For the 'drinks' category, David's examples were more detailed, but this trend did not continue throughout the task. Ben's prototypical 'toys' were more in line with the prototypes found in the online survey, and also showed an influence of external events. Both children's examples of 'pets' showed strong correlations with the prototypes found in the online survey, with David immediately recalling the highest scoring examples. The 'games' category was problematic for both children, who recalled 'games' that are unfamiliar to their families.

Part 2 was the most insightful area of the study, in which categorisation appeared to be more problematic for David. Overall, he was less accurate than Ben, and required more time to make categorical judgements. Both children were more likely to make inaccurate judgements for atypical stimuli, but were slightly more accurate with somewhat typical stimuli than prototypical stimuli, which conflicts previous research suggesting that prototypical stimuli should be verified most accurately (Mervis & Pani 1980; Gastgeb at al 2006). According to Gastgeb et al (2006), David's accuracy rates for less typical stimuli should have matched Ben's, while his decision times should have been slowed more by such stimuli. However, David's accuracy rates dropped more dramatically than Ben's, which also contrasts the results of Molesworth el al (2008), in which the majority of autistic and Asperger's Syndrome participants displayed equal typicality effects to their control group. The expected pattern of increased decision making time as typicality reduced was clearly seen in Ben's accurate responses, but was less evident for David, who made accurate judgements more quickly for prototypical stimuli than somewhat typical stimuli, but was fastest at verifying the atypical 'stickers'. However, more data would be needed to confirm this pattern as 'stickers' was the only atypical stimuli which David correctly judged. The differences between these results and those of Gestgeb et al (2006) could be due to a number of reasons. Firstly, the children studied here were younger than those in the aforementioned study, the results of which suggest that autistic individuals' categorisation improves as they age. Secondly, unlike David, the participants in the study of Gestgeb et al had been diagnosed with high-functioning autism. David's categorisation abilities may therefore be less intact than individuals with high-functioning autism.

The results may also be compared to the study of Church et al (2000), in which autistic children were less likely to use typicality when making categorical decisions, with almost half showing no sensitivity to the distance of stimuli from a prototype. As David displayed such a dramatic drop in accuracy rates from somewhat typical stimuli (100%), to atypical stimuli (25%), he appears to be sensitive to distance from prototype. Similarly, he was more likely to endorse, or at least consider endorsing, through prolonged decision making times, non-members which bore family resemblance to prototypical category members, such as the pencil case and nightlight, than non-members who bore no resemblance to the category, such as toilet, which again suggests sensitivity to family resemblance and prototypes.

The main limitation of this research is the small sample size, meaning that the results may not be representative of either population, although a range of tasks have been used to acquire as much valuable data as possible. The methodology could easily be replicated with a larger sample group to further explore and validate my findings. Different age groups could also be compared, to further explore the hypothesis of Gestgeb et al (2006), in which categorisation differences decrease as participants age. Another potential criticism is that the children may have previously had varying levels of exposure to the stimuli. While this could be overcome by using dot patterns, using stimuli that children are likely to come across in real life provides insight into how they may categorise somewhat unfamiliar items with knowledge which they have held for long periods, in day-to-day situations.

Although further study is necessary, my results support research suggesting that categorisation may be impaired in autistic individuals. It seems more likely that David's difficulties were due to a specific categorisation impairment than indirect issues related to autism, such as his impaired vocabulary, as

this cannot account for the prolonged decision making times in Part 2, where visual stimuli was also presented. David could be using 'hyper-specific representations' (Church et al 2010), which may explain his lower accuracy rates and longer decision times in Part 2. However, his decreased accuracy for atypical stimuli, and his prototypical recalls of 'pets' in Part 1, suggest that he is sensitive to typicality, and therefore does, at least at times, use prototypicality and family resemblance to categorise.

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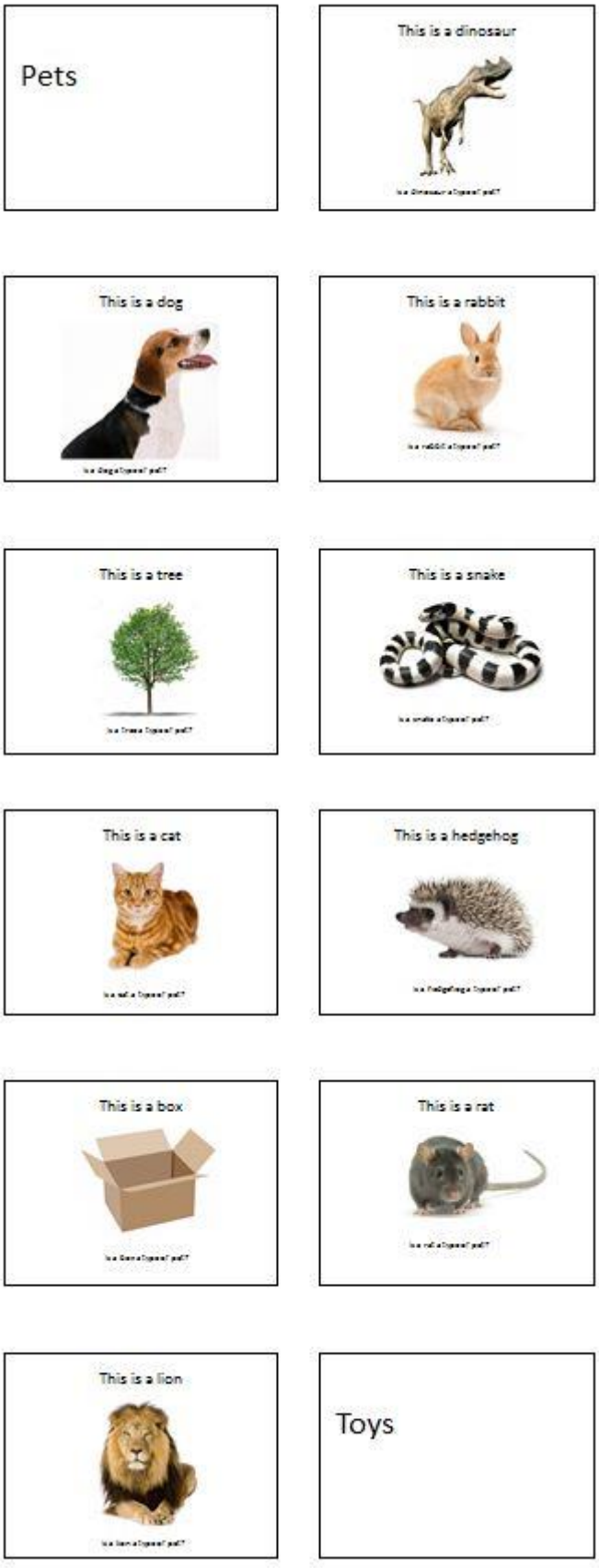
Appendices

Appendix A: Audio Recordings

All audio is stored on the USB labelled 'Appendix A'.

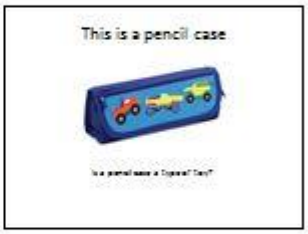
Appendix B: Stimuli from Part 2 of the Task




This is a doll


This is a remote controlled car


This is shampoo


This is a pencil case


These are some building blocks


These are some stickers


This is a toilet

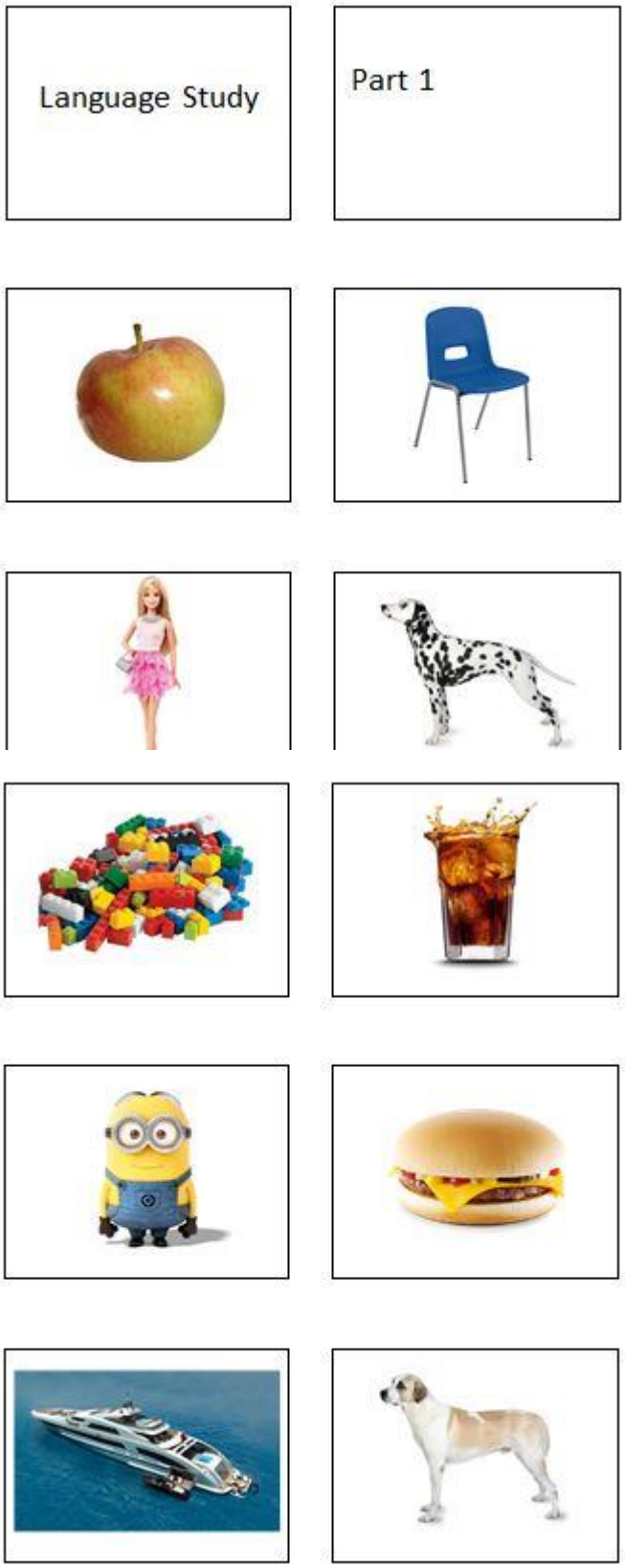

This is modelling clay


This is a teddy bear


This is a night light


Thank you very much!

Appendix C: Stimuli from the basic level task *(which was discarded for this project)*







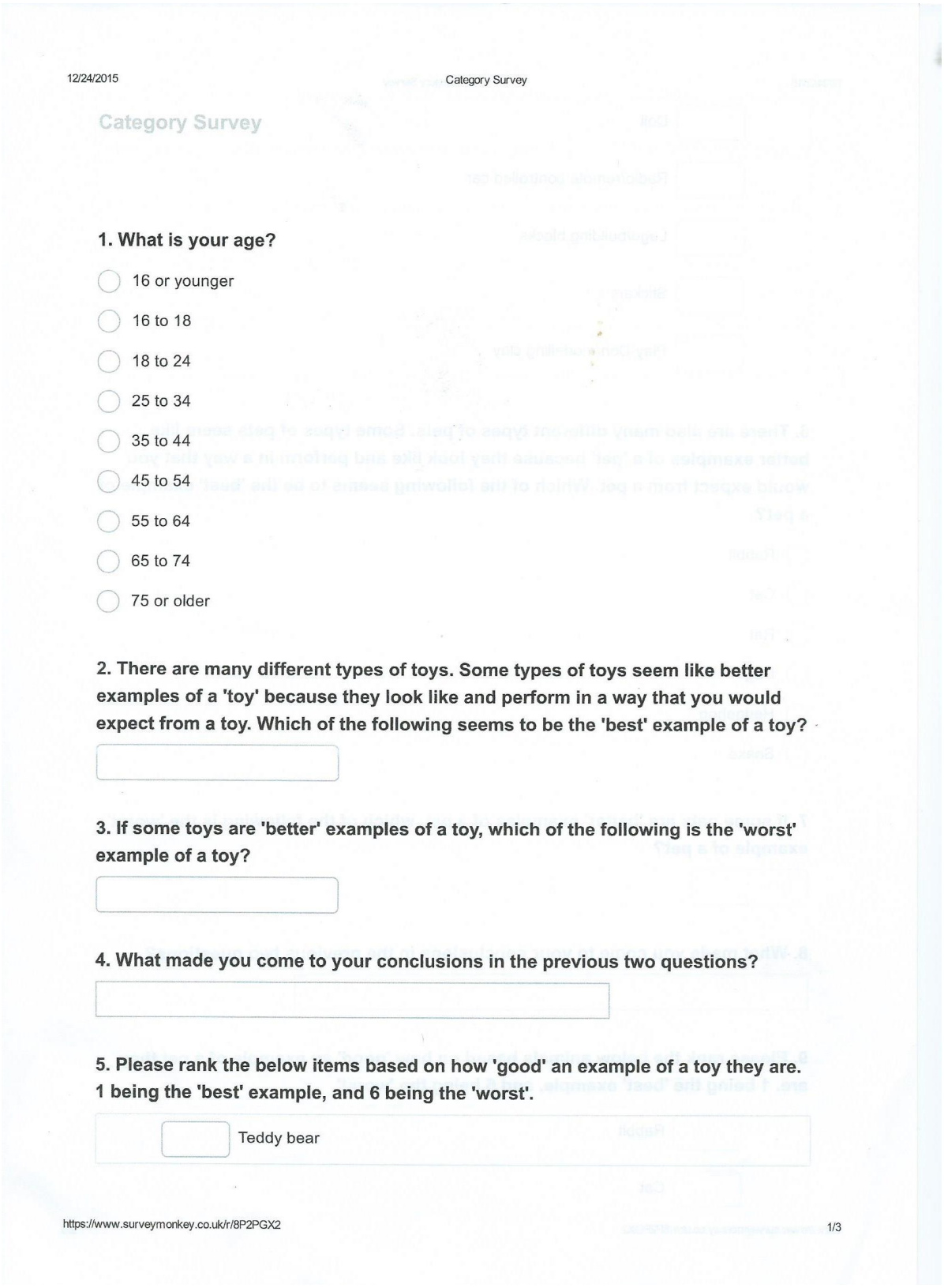




Appendix D: Table Highlighting Results from the Basic Level Representations Task

Stimuli Number	David	Ben	Adult Pilot
1	Apple	Apple	Apple
2	Chair	Chair	Chair
3	A doll	Barbie	Barbie
4	Dog	Dog	Dog
5	Lego	Lego	Lego
6	Eh… [inaudible]… I don't know… [after probing]… a vee[inaudible]	Cola Cola	Coke
7	Minion	Minion	Oh…Minions
8	Burger	Cob	Burger
9	Boat	Boat	Ship
10	Dog	Dog	Dog
11	Cake	Cake	Cake
12	Car	Car	Car
13	Tree	Tree	Tree
14	Phone	Phone	Phone
15	Cat	Cat	Cat
16	Err…Err…[after probing] ice-cream	Drink	Drink
17	Eh… Crisps	Crisps	Crisps
18	Bicycle	Motorbike	Bike
19	Bird	Robin	Bird
20	Eh… I don't [inaudible]… [after probing] got a hat	I don't know this one [after probing]…Barbie	Santa…[laughter]…it's an elf…it's one of them elves

Appendix E: Online Survey



12/24/2015 Category Survey

Category Survey

1. What is your age?

- 16 or younger
- 16 to 18
- 18 to 24
- 25 to 34
- 35 to 44
- 45 to 54
- 55 to 64
- 65 to 74
- 75 or older

2. There are many different types of toys. Some types of toys seem like better examples of a 'toy' because they look like and perform in a way that you would expect from a toy. Which of the following seems to be the 'best' example of a toy?

3. If some toys are 'better' examples of a toy, which of the following is the 'worst' example of a toy?

4. What made you come to your conclusions in the previous two questions?

5. Please rank the below items based on how 'good' an example of a toy they are. 1 being the 'best' example, and 6 being the 'worst'.

Teddy bear

https://www.surveymonkey.co.uk/r/8P2PGX2 1/3

- [ ] Doll
- [ ] Radio/remote controlled car
- [ ] Lego/building blocks
- [ ] Stickers
- [ ] Play-Doh/modelling clay

6. There are also many different types of pets. Some types of pets seem like better examples of a 'pet' because they look like and perform in a way that you would expect from a pet. Which of the following seems to be the 'best' example of a pet?

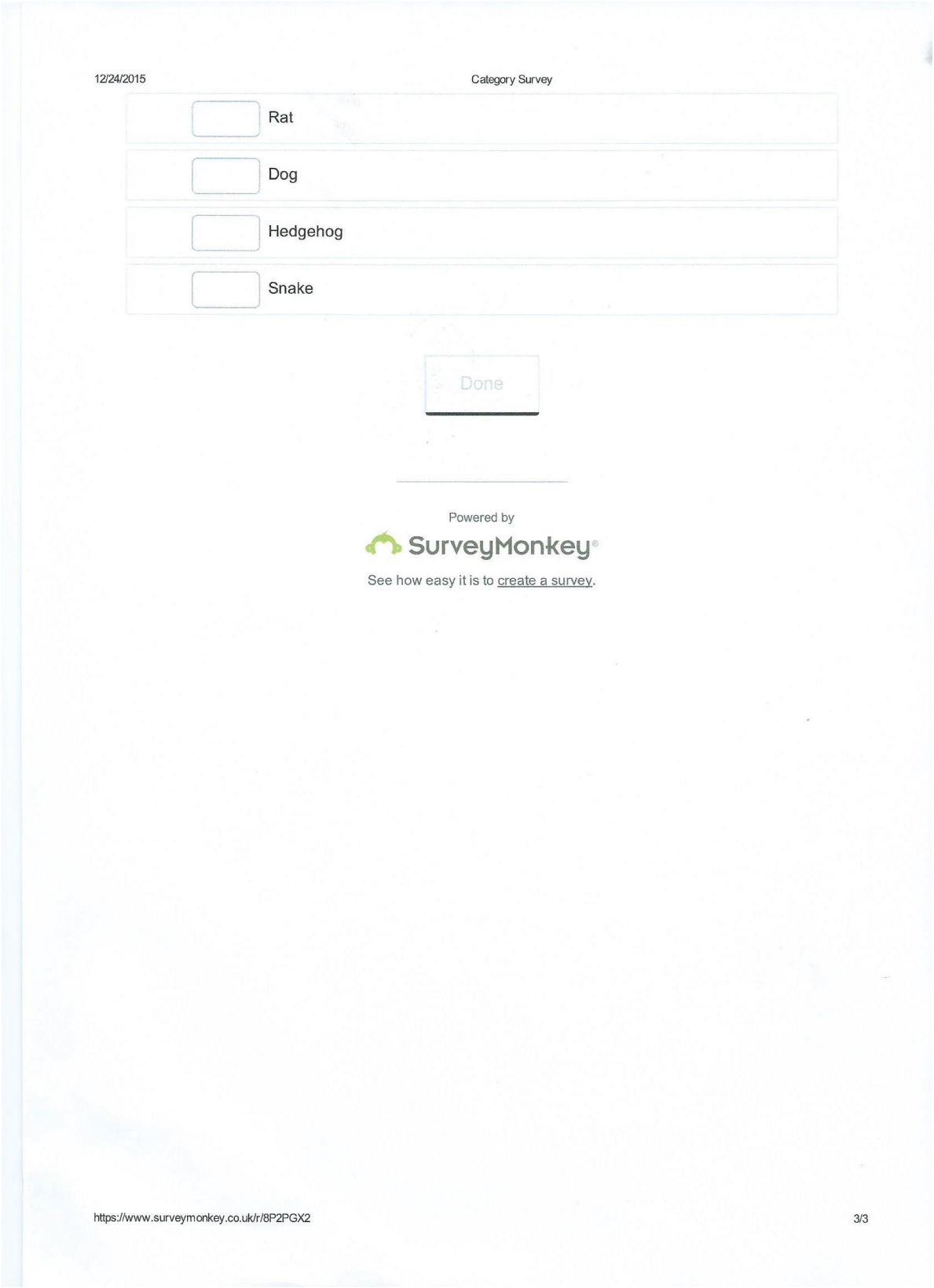
- ◯ Rabbit
- ◯ Cat
- ◯ Rat
- ◯ Dog
- ◯ Hedgehog
- ◯ Snake

7. If some pets are 'better' examples of a pet, which of the following is the 'worst' example of a pet?

8. What made you come to your conclusions in the previous two questions?

9. Please rank the below animals based on how 'good' an example of a pet they are. 1 being the 'best' example, and 6 being the 'worst'.

- [ ] Rabbit
- [ ] Cat



12/24/2015 Category Survey

- [ ] Rat
- [ ] Dog
- [ ] Hedgehog
- [ ] Snake

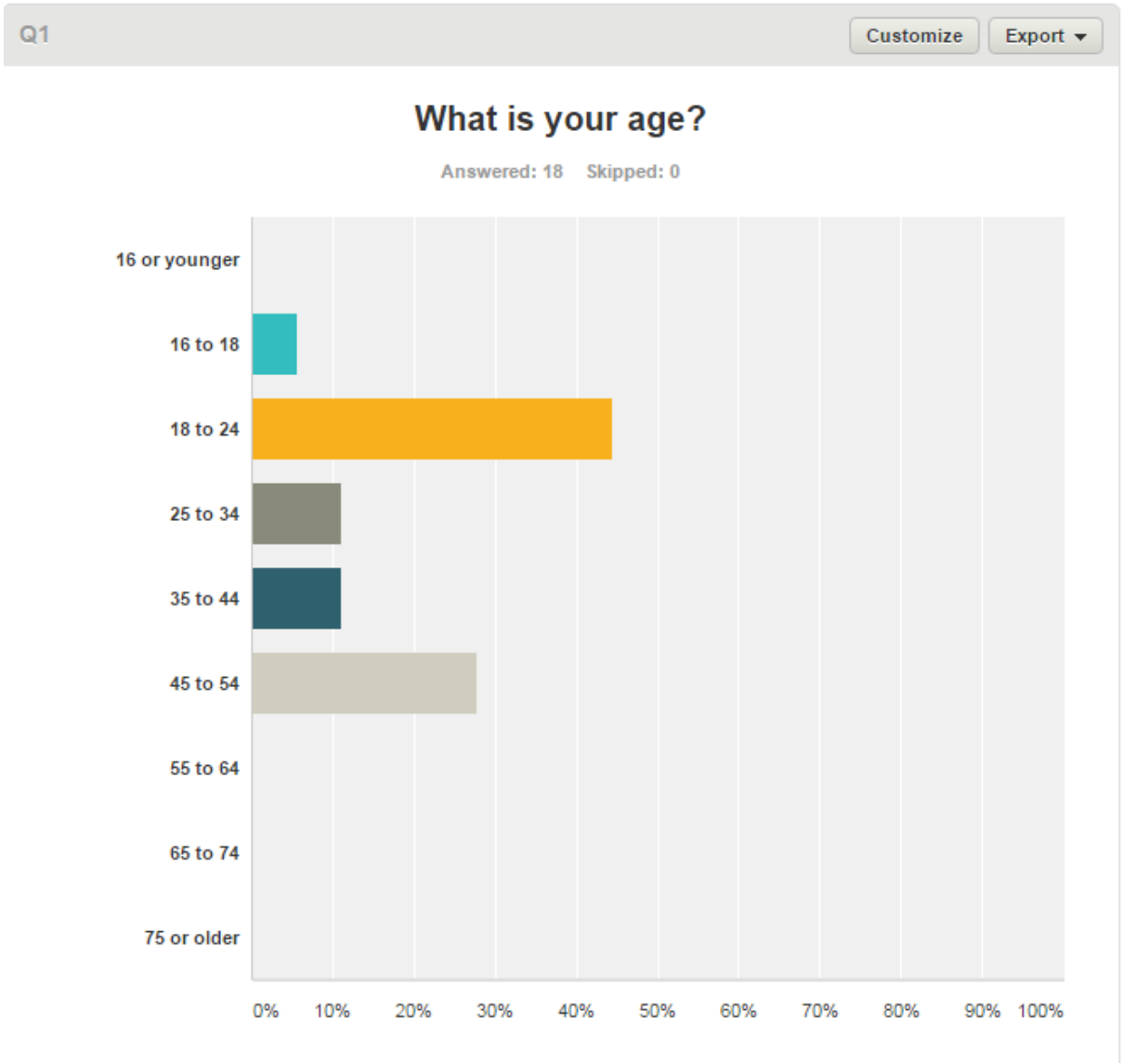
Done

Powered by SurveyMonkey

See how easy it is to create a survey.

https://www.surveymonkey.co.uk/r/8P2PGX2 3/3

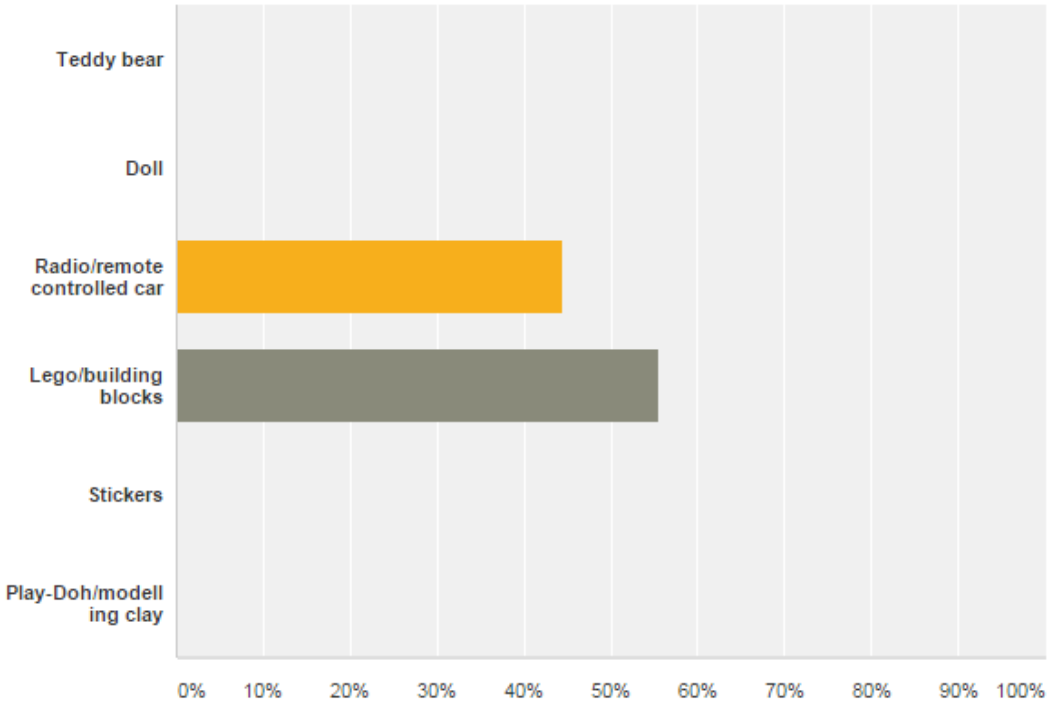
Appendix F: Online Survey Results



Q2 Customize Export

There are many different types of toys. Some types of toys seem like better examples of a 'toy' because they look like and perform in a way that you would expect from a toy. Which of the following seems to be the 'best' example of a toy?

Answered: 18 Skipped: 0

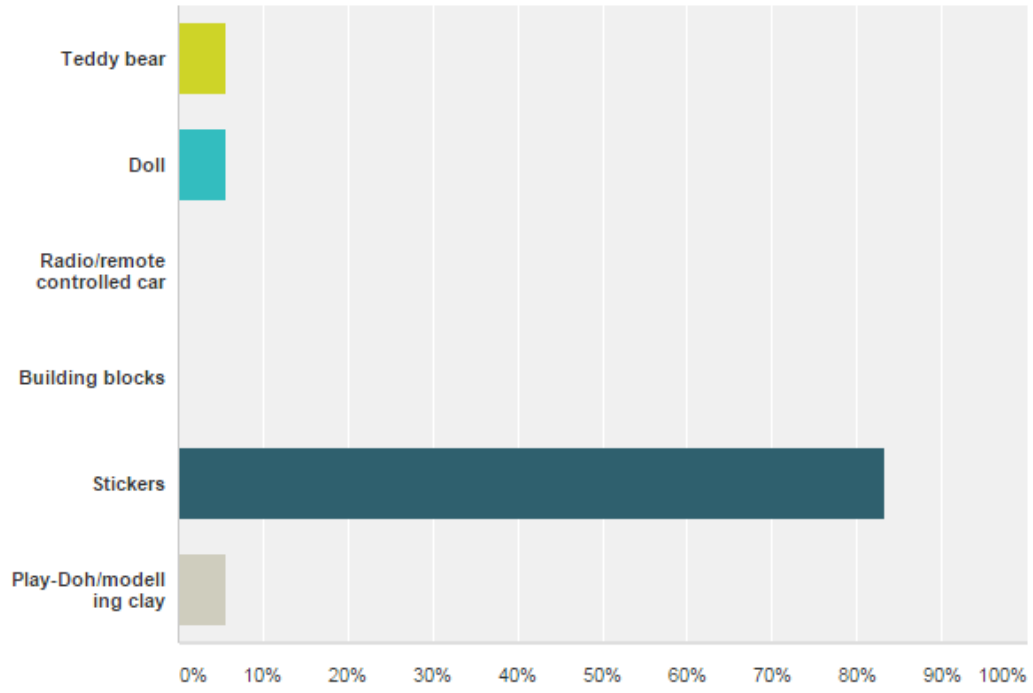


Answer Choices	Responses	
Teddy bear	0.00%	0
Doll	0.00%	0
Radio/remote controlled car	44.44%	8
Lego/building blocks	55.56%	10
Stickers	0.00%	0
Play-Doh/modelling clay	0.00%	0
Total		18

Q3 Customize Export

If some toys are 'better' examples of a toy, which of the following is the 'worst' example of a toy?

Answered: 18 Skipped: 0

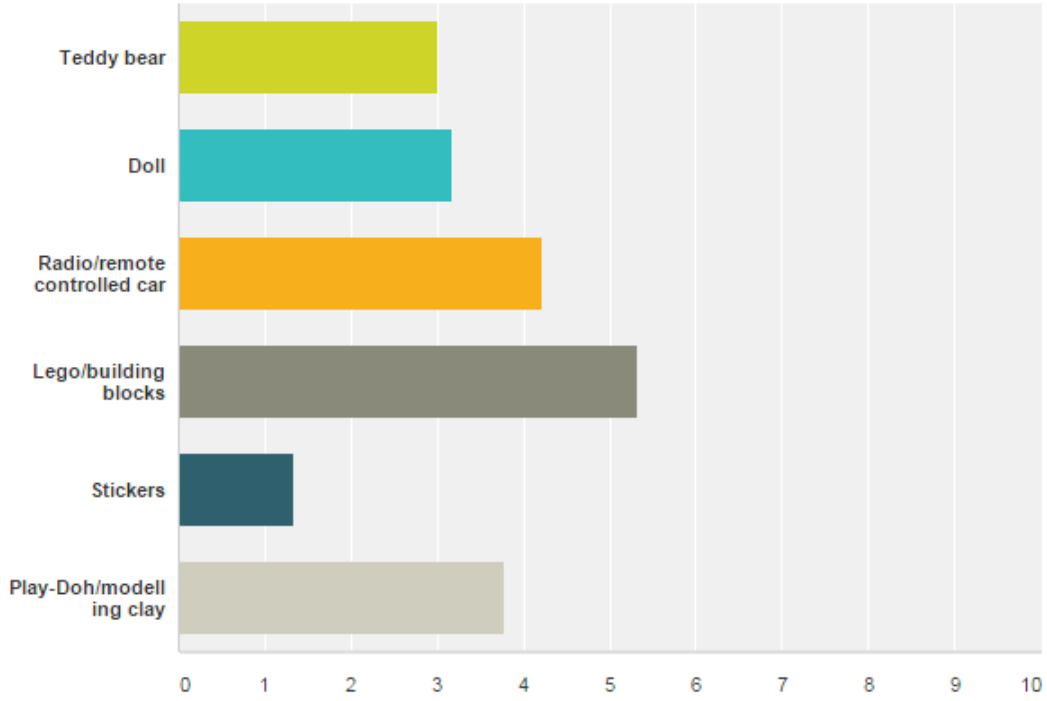


Answer Choices	Responses	
Teddy bear	5.56%	1
Doll	5.56%	1
Radio/remote controlled car	0.00%	0
Building blocks	0.00%	0
Stickers	83.33%	15
Play-Doh/modelling clay	5.56%	1
Total		18

Q5 Customize Export

Please rank the below items based on how 'good' an example of a toy they are. 1 being the 'best' example, and 6 being the 'worst'.

Answered: 18 Skipped: 0

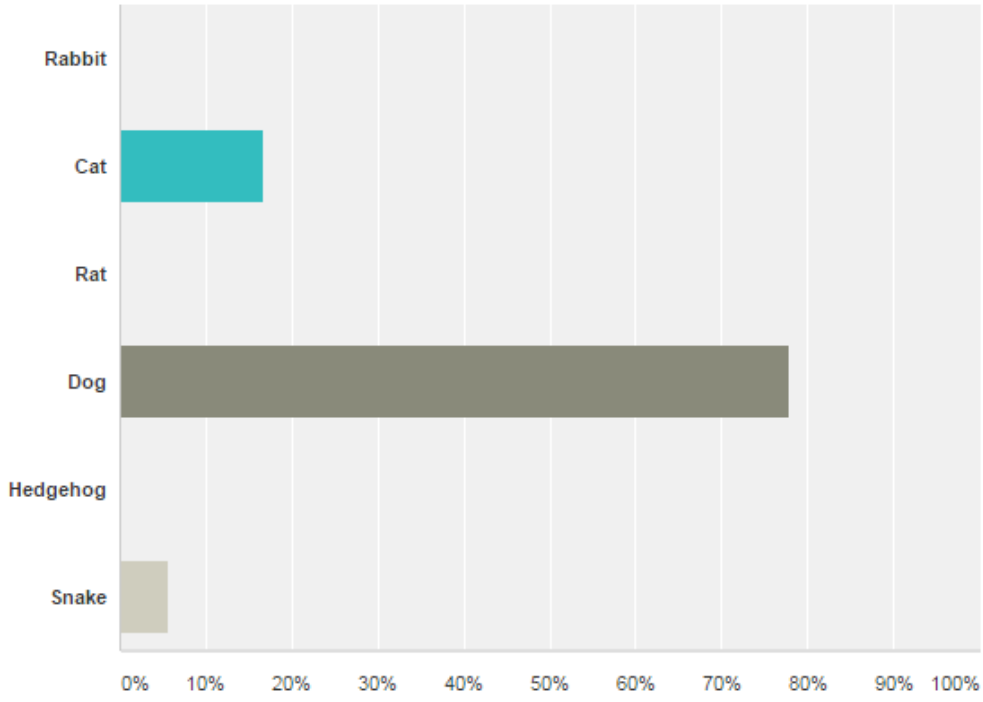


	1	2	3	4	5	6	Total	Score
Teddy bear	0.00% 0	5.88% 1	23.53% 4	35.29% 6	35.29% 6	0.00% 0	17	3.00
Doll	0.00% 0	0.00% 0	44.44% 8	33.33% 6	16.67% 3	5.56% 1	18	3.17
Radio/remote controlled car	38.89% 7	11.11% 2	11.11% 2	16.67% 3	16.67% 3	5.56% 1	18	4.22
Lego/building blocks	55.56% 10	33.33% 6	0.00% 0	11.11% 2	0.00% 0	0.00% 0	18	5.33
Stickers	0.00% 0	5.56% 1	0.00% 0	0.00% 0	11.11% 2	83.33% 15	18	1.33
Play-Doh/modelling clay	0.00% 0	44.44% 8	22.22% 4	5.56% 1	22.22% 4	5.56% 1	18	3.78

Q6 Customize Export

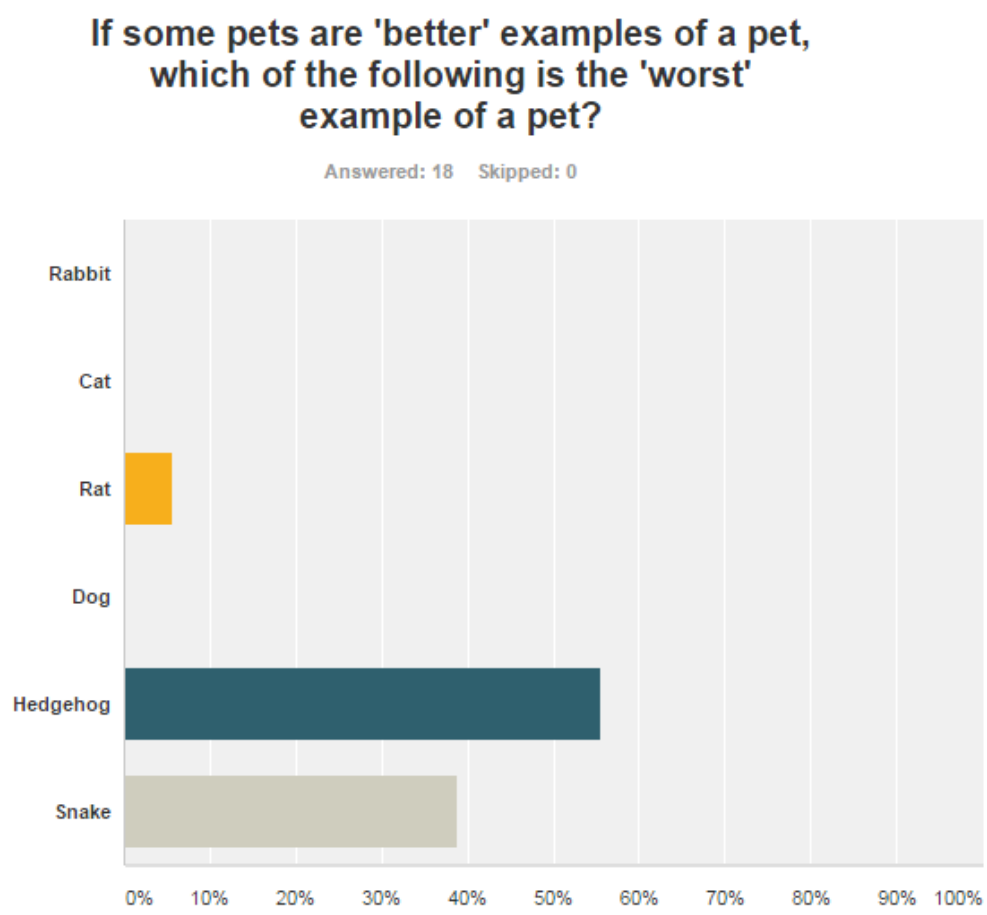
There are also many different types of pets. Some types of pets seem like better examples of a 'pet' because they look like and perform in a way that you would expect from a pet. Which of the following seems to be the 'best' example of a pet?

Answered: 18 Skipped: 0



Answer Choices	Responses	
Rabbit	0.00%	0
Cat	16.67%	3
Rat	0.00%	0
Dog	77.78%	14
Hedgehog	0.00%	0
Snake	5.56%	1
Total		18

Q7 Customize Export

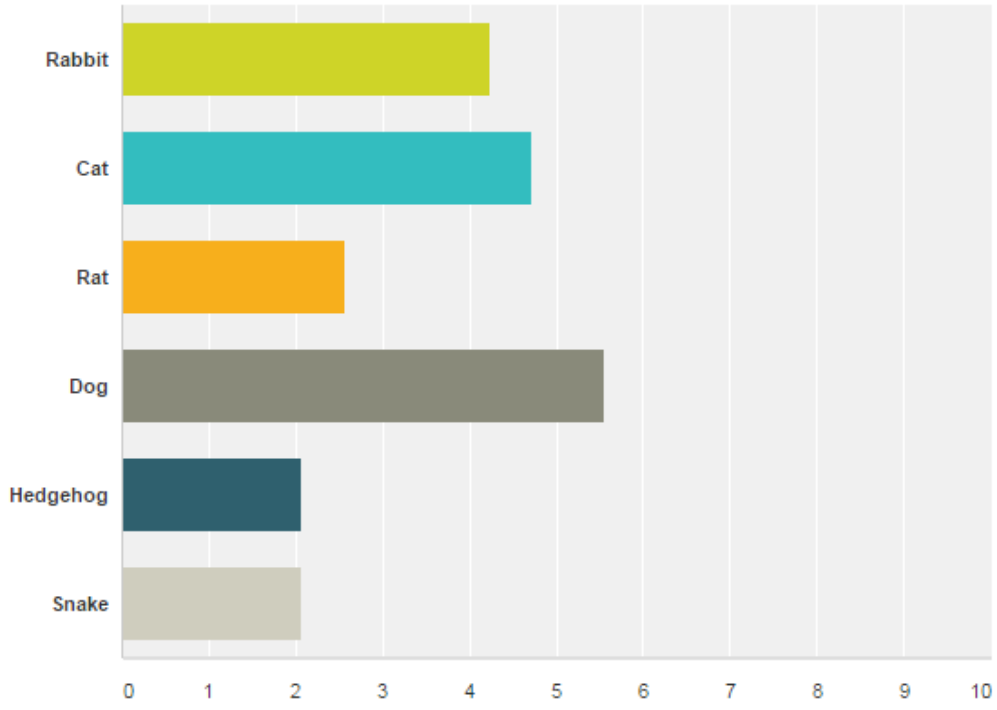


Answer Choices	Responses	
Rabbit	0.00%	0
Cat	0.00%	0
Rat	5.56%	1
Dog	0.00%	0
Hedgehog	55.56%	10
Snake	38.89%	7
Total		18

Q9 Customize Export

Please rank the below animals based on how 'good' an example of a pet they are. 1 being the 'best' example, and 6 being the 'worst'.

Answered: 18 Skipped: 0



	1	2	3	4	5	6	Total	Score
Rabbit	0.00% 0	23.53% 4	76.47% 13	0.00% 0	0.00% 0	0.00% 0	17	4.24
Cat	17.65% 3	52.94% 9	11.76% 2	17.65% 3	0.00% 0	0.00% 0	17	4.71
Rat	0.00% 0	0.00% 0	5.56% 1	50.00% 9	38.89% 7	5.56% 1	18	2.56
Dog	77.78% 14	16.67% 3	0.00% 0	0.00% 0	0.00% 0	5.56% 1	18	5.56
Hedgehog	5.56% 1	5.56% 1	0.00% 0	22.22% 4	11.11% 2	55.56% 10	18	2.06
Snake	0.00% 0	5.56% 1	5.56% 1	11.11% 2	44.44% 8	33.33% 6	18	2.06

Appendix G: David's NHS Diagnosis Report *(Confidential information has been removed)*

Derby Hospitals NHS
NHS Foundation Trust

[redacted]

SCoDAS

Re: Arthur Mogg - Dob 27/09/2010
[redacted]

Attends: [redacted]

Diagnosis: [redacted]trum Disorder
Disordered understanding of language and expressive language
Joint hypermobility
Hypotonia (low muscle tone)

Thank you for referring Arthur to the Social Communication Disorder Assessment Service. I saw him on the 5th November with both his parents. I was pleased to have reports from the speech and language therapist, Judith McAllister Educational Psychologist, Rebecca White Physiotherapist and detailed information from Springfield Primary School.

Family History
Arthur is the only child of Andrew and Elizabeth (Lizzie) Mogg, who are separated. Lizzie has two older children from a different relationship about whom there are no specific concerns, although Katie [redacted] is described as n[redacted]sted in numbers. The[redacted] known family history of autism spectrum disorder.

Past History
Mum's pregnancy with Arthur was uneventful. He was delivered by emergency caesarean section because of failure to progress. His birth weight was 9lbs 13½ ozs.

[redacted]

Derbyshire Children's at the Royal Derby Hospital, Uttoxeter Road, Derby, DE22 3NE, Tel: 01332 340131
[redacted]

Parents describe [redacted] as being an easy baby. His development was slow to progress in all areas. He was never interested in holding his bottle/cup.

Communication
[redacted]'s communication skills have been assessed by the speech and language therapist and detailed information is available in their reports.

Parents report that [redacted] has very little spontaneous chat, although can engage when he wants to.

In school it is reported that [redacted] does not start conversations, but will answer questions. He generally only talks when he is asking for help or responding to a question. He is reported not to make eye contact in social situations.

Social Interactions
At home, [redacted] mostly plays alone, although is happy for his parents or [redacted] to join in. He does not seek them out.

In school he plays alongside his peers but does not tend to develop relationships with them. He observes other children and will respond to them at times.

Play
Parents report that [redacted] did not engage in any imaginative play until about a year ago. He has recently started moving characters around his PlayMobile fort, pretending that the figures are fighting.

Repetitive Behaviours
[redacted] continues to tiptoe walk occasionally although this is much less than previously.

Motor Skills
[redacted] has been assessed by the paediatric physiotherapist. He has delay in his gross motor skills associated with low muscle tone and hypermobility of joints. He is showing improvement with his skills.

Summary
[redacted] presents with significant impairment of his communication skills, social interaction skills and play skills, with some repetitive stereotype behaviours. These difficulties are consistent with an **Autism Spectrum Disorder**. He is known to have disordered understanding of language and expressive language.

[redacted]'s development has been delayed in all areas including his motor skills. He has hypotonia and hypermobile joints.

I have given parents information about autism including the Early Support Programme Booklet and details of local and national support groups.

We discussed that it is important that [redacted] continues to receive appropriate support in school and we discussed that the secondary school environment may be more difficult for him and that the transition will have to be carefully managed.

Follow-up
I have not arranged to see [redacted] here again myself.

Yours sincerely

THIS DOCUMENT HAS BEEN REVIEWED AND ELECTRONICALLY APPROVED

[redacted]

Appendix H: Informed Consent Forms

INFORMED CONSENT FORM FOR FIELDWORK PROJECT

Project title: Study of children's categorisation

Purpose: The study is being conducted for the module *Language and the Mind* in the School of English at the University of Nottingham in order for students to gain a greater understanding of how language is represented in and processed by the mind.

Please, read the following information and circle as response as necessary:

- I confirm that the purpose of the study has been explained and that I have understood it. (YES/ NO)
- I have had the opportunity to ask questions and they have been successfully answered. (YES/NO)
- I understand that my child's participation in this study is voluntary and that I am free to withdraw them, or they may withdraw themselves, from the study at any time and without having to give a reason and without consequence. (YES/NO)
- I understand that all data are anonymous and that there will not be any connection between the personal information provided and the data. (YES/NO)
- I understand that my child has the right to their own data. (YES/NO)
- I understand that there are no known risks or hazards associated with participating in this study. (YES/NO)
- I confirm that I have read and understood the above information and that I agree to allow my child to participate in this study. (YES/NO)

Signature of Parent/Guardian: [signature] Date: 20.12.15

Parent/Guardian's Name (in block capitals): MICHAELA GARTON

Participant's Name (in block capitals): WILLIAM GARTON

Researcher's signature: [signature] Date: 20/12/15.

INFORMED CONSENT FORM FOR FIELDWORK PROJECT

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Please, read the following information and circle a response as necessary:

- I confirm that the purpose of the study has been explained and that I have understood it. — YES/ NO
- I have had the opportunity to ask questions and they have been successfully answered. — YES/NO
- I understand that my child's participation in this study is voluntary and that I am free to withdraw them, or they may withdraw themselves, from the study at any time and without having to give a reason and without consequence. — YES/NO
- I understand that all data are anonymous and that there will not be any connection between the personal information provided and the data. — YES/NO
- I understand that my child has the right to their own data. — YES/NO
- I understand that there are no known risks or hazards associated with participating in this study. — YES/NO
- I confirm that I have read and understood the above information and that I agree to allow my child to participate in this study. — YES/NO

Signature of Parent/Guardian: EA Mogg Date: 20/12/15

Parent/Guardian's Name (in block capitals): ELIZABETH MOGG

Participant's Name (in block capitals): ARTHUR MOGG

Researcher's signature: [signature] Date: 20/12/15

INFORMED CONSENT FORM FOR FIELDWORK PROJECT

Project title: Study of children's categorisation

Purpose: The study is being conducted for the module *Language and the Mind* in the School of English at the University of Nottingham in order for students to gain a greater understanding of how language is represented in and processed by the mind.

Please, read the following information and circle as response as necessary:

- I confirm that the purpose of the study has been explained and that I have understood it. YES/~~NO~~
- I have had the opportunity to ask questions and they have been successfully answered. YES/~~NO~~
- I understand that my participation in this study is voluntary and that I am free to withdraw from the study at any time without having to give a reason and without consequence. YES/~~NO~~
- I understand that all data are anonymous and that there will not be any connection between the personal information provided and the data. YES/~~NO~~
- I understand that I have the right to my own data. YES/~~NO~~
- I understand that there are no known risks or hazards associated with participating in this study. YES/~~NO~~
- I confirm that I have read and understood the above information and that I agree to participate in this study. YES/~~NO~~

Participant's Signature: EA Mogg Date: 18/12/15

Participant's Name (in block capitals): E. A. MOGG

Researcher's signature: Date: 18/12/15

Appendix I: Ethics Approval Form

Ethics Approval for data collection

- [x] Data gathering activities involving schools and other organizations will be carried out only with the agreement of the head of school/organization, or an authorised representative, and after adequate notice has been given.
- [x] The purpose and procedures of the project, and the potential benefits and costs of participating (e.g. the amount of their time involved), will be fully explained to prospective participants at the outset.
- [x] My full identity will be revealed to potential participants.
- [x] Prospective participants will be informed that data collected will be treated in the strictest confidence and will only be reported in anonymised form, but that I will be forced to consider disclosure of certain information where there are strong grounds for believing that not doing so will result in harm to research participants or others, or (the continuation of) illegal activity.
- [x] All potential participants will be asked to give their explicit, normally written consent to participating in the research, and, where consent is given, separate copies of this will be retained by both researcher and participant. These consent forms should be submitted as an Appendix, along with this form.
- [x] In addition to the consent of the individuals concerned, the signed consent of a parent, guardian or 'responsible other' will be required to sanction the participation of minors (i.e. persons under 16 years of age) or those whose 'intellectual capability or other vulnerable circumstance may limit the extent to which they can be expected to understand or agree voluntarily'.
- [x] Undue pressure will not be placed on individuals or institutions to participate in project activities.
- [x] The treatment of potential research participants will in no way be prejudiced if they choose not to participate in the project.
- [x] I will provide participants with my contact details (and details of the module convenor) in order that they are able to make contact in relation to any aspect of the project, should they wish to do so.
- [x] Participants will be made aware that they may freely withdraw from the project at any time without risk or prejudice.
- [x] Research will be carried out with regard for mutually convenient times and negotiated in a way that seeks to minimise disruption to schedules and burdens on participants.
- [x] At all times during the conduct of the research I will behave in an appropriate, professional manner and take steps to ensure that neither myself nor research participants are placed at risk.
- [x] The dignity and interests of research participants will be respected at all times, and steps will be taken to ensure that no harm will result from participating in the research.
- [x] The views of all participants in the research will be respected and special efforts will be made to be sensitive to differences relating to age, culture, disability, race, sex, religion and sexual orientation, amongst research participants, when planning, conducting and reporting on the research.
- [x] Data generated by the research will be kept in a safe and secure location and will be used purely for the purposes of the project (including dissemination of findings). No-one other than markers and examiners will have access to any of the data collected.
- [x] Research participants will have the right of access to any data kept on them.
- [x] All necessary steps will be taken to protect the privacy and ensure the anonymity and non-traceability of participants – e.g. by the use of pseudonyms, for both individual and institutional participants.
- [x] Where possible, participants will be provided with a summary of research findings and an opportunity for debriefing after taking part in the research.
- [ ] If working with children 16 and under for a prolonged period of time, I have received Advanced Criminal Records Bureau (CRB) disclosure.

Signed EW

Date 18/12/2015