Perspectives Organize Information in Mind and Nature: Empirical Findings of Point-View Perspective (P) in Cognitive and Material Complexity

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Abstract: The importance of perspective-taking crosses disciplines and is foundational to diverse phenomena such as point-of-view, scale, mindset, theory of mind, opinion, belief, empathy, compassion, analysis, and problem solving, etc. This publication gives predictions for and a formal description of *point-view Perspectives* (P) or the "P-rule". This makes the P-rule foundational to systems, systems thinking and the consilience of knowledge. It is one of four universals of the organization of information as a whole. This paper presents nine empirical studies in which subjects were asked to complete a task and/or answer a question. The samples vary for each study (ranging from N = 407 to N = 34,398) and are generalizable to a normal distribution of the US population. As was evident in Cabrera, "These studies support—with *high statistical significance*—the predictions made by DSRP Theory (Distinctions, Systems Relationships, Perspectives) point-view Perspectives including its: universality as an observable phenomenon in both mind (cognitive complexity) and nature (material complexity) (i.e., parallelism); internal structures and dynamics; mutual dependencies on other universals (i.e., Distinctions, Systems, and Relationships); role in structural predictions; and, efficacy as a metacognitive skill". These data suggest that point-view Perspectives (P) observably and empirically exist, and that universality, efficacy, and parallelism (between cognitive and material complexity) exist as well. The impact of this paper is that it provides empirical evidence for the phenomena of point-view perspective taking ("P-rule") as a universal pattern/structure of systems thinking, a field in which scholarly debate is often based on invalidated opinioned frameworks; this sets the stage for theory building in the field.

Keywords: perspectives; point-view; universals; cognitive complexity; systems thinking; DSRP Theory; material complexity; systems science

1. Introduction

It is typical to provide an Introduction, Methods, Results, Discussion and Conclusion for empirical studies. We keep to the norm but we share seven studies rather than just one. It would have benefited the authors more to publish seven separate papers about each different study. However, the authors chose to keep the studies together and create an "ecology of empirical studies". Four out of seven studies were relatively small. They were usually a single question that tested a particular hypothesis and isolated a specific effect. In addition, the results are better understood as a whole rather than as isolated parts because the studies focus on specific aspects of the same phenomena (point-view Perspectives Rule). If the reader wishes to read each study individually, they can do so simply by reading Sections 2.1, 3.1 and 4.1 together.

Perspective is central to the field of systems thinking [1–14] or cognitive complexity. Perspective taking is a cognitive act that underlies numerous positive and negative phenom-

ena (i.e., empathy, compassion, analytics, bias, stereotypes, conflict, prejudice, etc.) . That is, perspective, in and of itself, is not inherently positive or negative but both [13,15–18]. The wider point we are making is that it is universal. Indeed, perspective taking underlies numerous other phenomena including: frame of reference [19–22], scale [23,24], point of view [25–28], viewpoint [6,29], mindset [30,31], beliefs [32,33], opinions [34], bias [13,16,35,36], compassion [37–40], empathy [41–43], analytical thinking [44], critical thinking [45], problem solving [46,47], and many more. Understanding perspective taking is an absolutely essential part of understanding not only the universe and natural systems (material complexity) but also systems thinking and human cognition (cognitive complexity) [44,48–53].

1.1. Empirical Findings of Perspectives Across the Disciplines

The ecology of nine studies exists in the context of a much wider literature of literature reviews and empirical studies on perspective taking. As Cabrera writes [54]

"There is an abundance of interest, literature, and empirical findings on perspective taking across the disciplinary spectrum (i.e., the physical, natural, social and applied sciences). Perspective is one of the most important aspects of human cognition, given our status as social animals. In a literature review of perspective taking [53] a number of empirical studies show the universality of perspectives across the disciplines [5,6,8,9,11–14,19,55–78]. In the cognitive sciences (as well as the physical and natural sciences) it is clear that perspectives are ever present [8,11,19,56–59,61,63,64,66,75].

It is also clear that perspectives are not enough. That they are necessary but not sufficient to explain an underlying, universal, structural grammar of cognition. Empirical findings from the literature also reveal what DSRP Theory predicts: that point-view perspective is integral with other universals (i.e., Distinctions, Systems, Relationships) [49,79–110]."

Figure 1 shows the disciplinary distribution of this research.
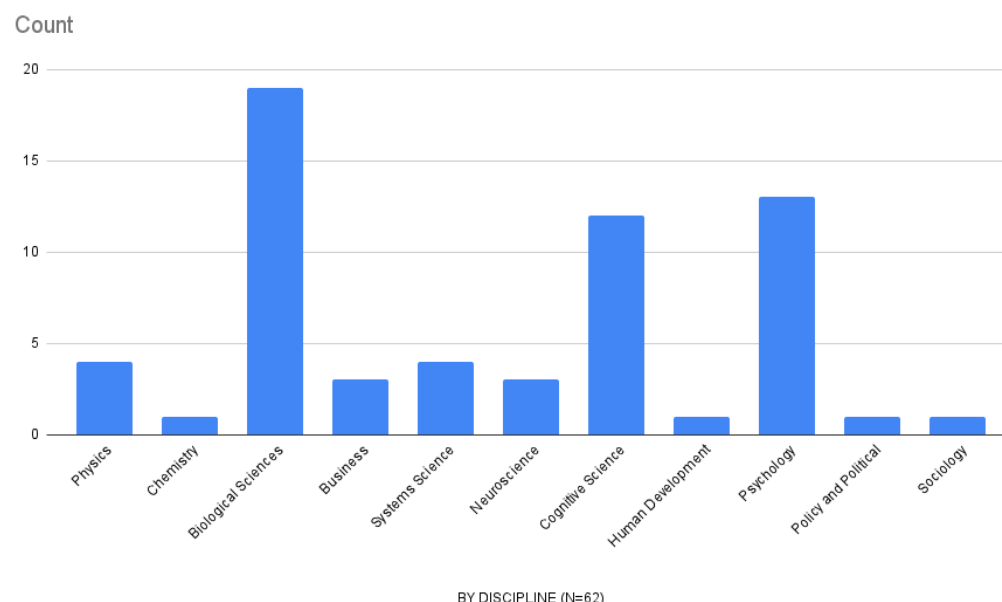
Figure 1. Point-view Perspectives (P) Research Across the Disciplines (adapted from [53]).

Cabrera's 2021 review of research [53] is built upon other older literature reviews [48,51]. It is part of an accumulating body of evidence in support of the predictions made by DSRP Theory generally and point-view Perspectives in particular. Over 150 studies are included in this literature review. It therefore represents a "tip of the iceberg" because the studies presented are a small sample of the studies that exist. The findings, utility, and application

of point-view Perspectives (P) are ubiquitous and pervasive. A few of the studies from the literature review [53] include:

- Zwick's [61] findings that show *experimentally* (and not metaphorically, but materially) that atoms have their own perspective on their environment;
- Endler's 2012 [55] research shows perspective taking in the mate-display building behavior of Bowerbirds;
- Baron-Cohen et al.'s 1985 [59] groundbreaking work on "theory of mind" in the Sally-Anne Experiments;
- Premack and Woodruff's (1978) [8] research demonstrating that chimpanzees have "theory of mind" perspective taking;
- Chamovitz [57] and Montesinos-Navarro et al. [58] independently discovered that plants have been shown to take Perspective; and
- Vallar et al.'s 1998 [19] use of fMRI technology to investigate how the brain creates an "egocentric spatial frame of reference".

1.2. Theoretical Work on Perspectives

The simplest accurate statement of DSRP Theory is thus [54]:

"the ways information is/is not bounded, arranged, and interconnected from frames of reference determines what actually exists and what we think exists."

DSRP Theory details quite a bit more than this simplification relays [48,51,54,111–114]. There is more empirical evidence supporting DSRP Theory than any other existing systems theory or framework (which is not a theory) [48,53,54,115–121]. The reader should look at the other citations in this publication for more information on DSRP Theory as this paper focuses only on the perspectives rule in DSRP.
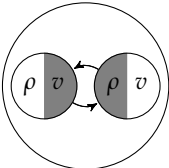
Cabrera [48] expanded on perspective taking theoretically by proposing in DSRP Theory that: (1) perspectives are universal to mind and nature; (2) all perspectives (P) constitute an *observer/observed* relationship between point (p) and view (ρ) variables (what Cabrera calls *elements*); and (3) that Perspectives are not reserved merely for people or "things with eyes". That is: any person, place, thing, or idea; any element in an ecology; or any node in any network has a unique perspective that exists in nature (material systems) and can be taken by the human mind. For example, an elk and wolf in a Yellowstone ecosystem have a perspective and humans can cognitively take their perspectives to better understand the system. Likewise, an item, like an atom or a blood cell has a unique perspective, as does a position in space, or any concept (thing: economic, structural, political, etc.). DSRP Theory explained that not only do these perspectives exist in the 'real' material world, perspectives can also be taken cognitively to give us access to new insights. Cabrera explains [122], "DSRP Theory further stipulated that awareness of these existential perspectives (metacognition of P-rule) can increase one's effectiveness in thinking about systems, modeling systems, or in increasing cognitive fluidity, complexity and robustness". This critical insight—part of DSRP Theory—exposed the universality of point-view Perspectives ("P-rule") at the theoretical level. Table 1 shows the structure of the point-view Perspectives rule according to DSRP Theory.

Note that DSRP theory comprises four dynamically interacting structures: identity-other Distinctions (D), part-whole Systems (S), action-reaction Relationships (R), and point-view Perspectives (P). Herein, we focus on point-view Perspectives (P). However, DSRP Theory also predicts that the four rules are dynamical and are necessary and sufficient. Thus, for a perspective to exist, the other rules need to be at play. Table 2 illustrates how Perspective itself, requires Distinctions, Systems, and Relationships to exist.

Table 1. Point-view Perspective Rule or P-rule.

$P \equiv \rho \Leftrightarrow v$	A *Perspective* is defined as *point* co-implying *view*		
A *point* exists	A *view* exists	*point* co-implies *view*	A *Perspective* exists
ρ	v	$\rho \Leftrightarrow v$	$\equiv P$

Table 2. DSRP is Necessary and Sufficient for P-rule [54].

Any point-view **PERSPECTIVE** is also:

- Two Distinctions [possible]: $\{\rho, \neg\rho\}$ and $\{v, \neg v\}$
- A Relationship (R_r^a): $\rho \xleftrightarrow[\text{observes}]{\text{observed}} v$
- A System with parts: ρ, v, and their relationship (R_r^a)
- Two Perspectives [possible]: ρ and v

The nine studies described herein represent an "ecology of empirical studies" which are further supported by multiple meta-analytical reviews of the literature [48,53,116] and 3 other "ecologies" that focus on: identity-other Distinctions (D) [119], part-whole Systems (S) [121], and action-reaction Relationships (R) [120]. The reader may want focus on this ecology of nine studies (herein) by reading them as an integrated ecology of studies. Alternatively, the reader may want to digest each study one at a time by reading, for example the Methods (Section 2.1), Results (Section 3.1), and Findings (Section 4.1) for a single study.

1.3. Research Questions that Underlie the Hypotheses for P-Rule Studies

The studies presented in this paper are part of a larger ecology of research questions based on the predictions of DSRP Theory and their various implications. This ecology of studies empirically investigates these predictions. Table 3 shows the matrix of research questions upon which our hypotheses, null hypotheses, and research design and findings are based.

Table 3. Research Questions that Underlie the Hypotheses for P-rule Studies.

	Existential (Basic Research)	Efficacy (Applied Research)
Mind (cognitive complexity)	**Does DSRP Exist in Mind?** (i.e., Does DSRP exist as universal, material, observable cognitive phenomena?)	**Is Metacognitive Awareness of DSRP Effective?** (i.e., Does it increase ability to align cognitive complexity to real-world complexity? (a.k.a., parallelism)
Nature (material complexity)	**Does DSRP Exist in Nature?** (i.e., Does DSRP exist as universal, material, observable phenomena?)	
	Empirical Basis	

Thus, this set of studies on the P-rule of DSRP Theory is part of a research program that attempts to answer the research questions. The first is to establish the *existence* of the Perspectives rule in Mind and Nature. The second is to apply the Perspectives rule to demonstrate the *efficacy* of the rule in understanding Mind and Nature. The following research questions are addressed in this publication:

1. *Existential* (Basic research): focused on the question, as Cabrera [119] explains, "Does DSRP Exist? Does DSRP exist as universal, material, observable phenomena?"
2. *Efficacy* (Applied research): focused on the question as Cabrera [122] explains, "Is DSRP Effective? Does metacognition of DSRP increase effectiveness in navigating cognitive

complexity in order to understand system (material) complexity? This gets at the critically important question of '*parallelism*'—defined as the probability that our cognitive organizational rules align with nature's organizational rules—which is central to the idea of the Systems Thinking/DSRP Loop[1] (Figure 2).
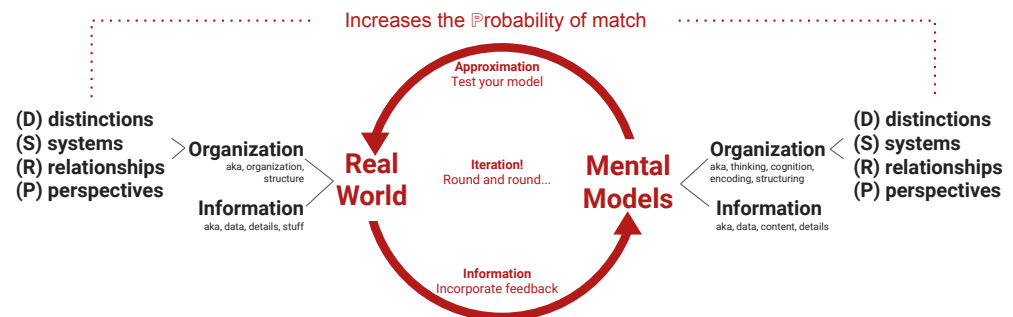

Figure 2. The ST/DSRP Loop [122].

Specifically, the empirical studies in this paper focus on the P-rule, or the "P" in DSRP Theory, although other papers offer research on the identity-other Distinctions (D) studies [119], part-whole Systems (S) studies [121], and action-reaction Relationships (R) studies [120]. The empirical studies discussed in this publication address specific questions about the Perspectives rule:

1. Does the perspective rule *exist* in Mind and Nature? (in the same way Evolution or Heliocentrism *exists*)
2. Does metacognitive awareness of the Perspective rule *increase effectiveness* in cognitive complexity, systems thinking, or fluidity, etc.?

There are nine studies presented herein. They include: *Only See Blue Study*, *Where's the Plant Study*, *What's a Bat Study*, *Where's Waldo Study*, *Fishtank Perspective Study*, *P-Mapping Study*, *P-STMI Study*, and *P-Fishtank Study*. Although the design of these research studies focused on these questions separately, there is some overlap among these studies in their results. As a general guideline, however, one is safe to conclude that the *Only See Blue Study*, *Where's the Plant Study*, *What's a Bat Study*, *Where's Waldo Study* and *Fishtank Perspective Study* focused on *existential* questions and the *P-Mapping Study*, *P-STMI Study*[2], and *P-Fishtank Study* focused on *efficacy*.

The ecology of studies presented herein, aims to quantify the theoretical predictions made by DSRP Theory, and their various implications by showing that they are observable and significant. This research empirically tests and—with highly statistically significant results—supports these specific predictions. In what follows, we present nine empirical studies that together form an ecology of these findings.

2. Materials and Methods

The following is true for all studies, unless otherwise noted. Subjects were asked to respond to a task. Prior to deployment of the studies, several pilot tests were conducted with small samples to ensure construct validity and to correct language-based confusion. Sample size for the studies was based on generalizability such that given a Confidence Level (CL = 95%), Confidence Interval (CI = 5), and a US population of 350,000,000, the sample size was calculated to be 384. We chose samples larger than this number). The samples range from N = 407 to 34,398 (which are outlined per study below). Samples were based on normal distribution of US population. Samples were identified using the following demographics (unless otherwise noted): US population; 50/50 gender split; an age range of 22–65 years old to avoid underage subjects; and representative of the census numbers for education (e.g., completion of high school, community college, college, masters, PhD). All responses were voluntary and administered online in the respondent's

place of choice. Demographic variables were only used for sampling purposes to ensure representation proportional to the US population. These demographics were not the focus of these studies (although we do report on them where there was statistical significance in results). The purpose of these studies was to assess the universality and similarity across demographics. Stratified sampling methods matching the census of the US population and voluntary-response sampling was used for all studies unless otherwise noted. The Only See Blue, Ball-Dot-Hole, Where's Waldo?, Financial Fish, What's a Bat?, and Wheres the Plant? studies all utilized a single sample. The P-Mapping study utilized an independent, self-selecting sample of individuals who used systems mapping software. The P-STMI study used an independent, self-selecting sample of individuals who voluntarily completed a survey. For the P-Fishtank, a stratified sampling method matching the census of the US population and voluntary-response sampling was used with independent samples for D, S, R, and P.

Procedurally, the Only See Blue, Ball-Dot-Hole, Where's Waldo?, Financial Fish, What's a Bat?, and Wheres the Plant? studies were presented in a particular order (as listed above) to reduce possible priming effects between and among the questions.

Data was collected and analyzed. Incomplete/nonsense data were removed. Each study below has a detailed methods section. Examples of incomplete data are blank fields. Examples of nonsense data include *only* obvious nonsense such as "asfhjbasfh" or "cut and paste" of the question across all answers.

2.1. The Only See Blue Study Methods

Statistical analysis (N = 407) was performed using R v 3.6.3. (Statlib, Auckland, New Zealand) Counts and percentages were used to summarize categorical variables and the mean ± standard deviation (SD) or the median/interquartile range [IQR] was used for continuous normal and non-normal variables, respectively. Chi-square test of independence was used to assess the association between categorical variables. Those who preferred not to state any of the socio-demographic information were coded as missing. Age and education were recoded to simplify the analysis. Binary logistic regression was used to assess factors associated with choosing a number other than seven (following a different cognitive perspective). Chi-square test for goodness of fit assessed whether the probability of choosing a number other than four was significantly different from the expected probability of zero (i.e., there is a difference in the cognitive perspective between respondents). Hypothesis testing was performed at 5% level of significance.

2.2. The Where's the Plant? Study Methods

Statistical analysis (N = 407) was performed using R v 3.6.3. Counts and percentages summarized categorical variables. Pairwise McNemar's test was used to assess whether the proportion of correct answers was significantly different between each pair of the four scenarios. McNemar's test was used to take into account the paired nature of the data (each respondent was presented with all possible scenarios). Generalized linear mixed modelling (GLMM) was used to assess the association between perspective, direction of the person in the image, and the probability of answering the question correctly. Hypothesis testing was performed at 5% level of significance. Procedurally, the questions where ordered as presented in the results.

2.3. The What's a Bat? Study Methods

Statistical analysis (N = 407) was performed using R v 3.6.3. Counts and percentages were used to summarize categorical variables. Pairwise McNemar's test was used to assess whether the distribution of answers was significantly different between the three situations. Chi-square test for goodness of fit assessed whether the observed proportions were significantly different from the proportions expected under the null hypothesis. McNemar's test was used to take into account the paired nature of the data (each respondent was presented with all possible scenarios). Generalized multinomial logistic regression (GLMM) was

used to assess the association between the situation and perception of the bat. Hypothesis testing was performed at 5% level of significance. Procedurally, this study had 3 questions presented in a particular order as detailed in the analysis.

2.4. The Ball-Dot-Hole Study Methods

Statistical (N = 407) analysis was performed using R v 3.6.3. Counts and percentages were used to summarize categorical variables. Chi-square test for goodness of fit was used to assess whether the observed proportions were significantly different from the proportions expected under the null hypothesis. We test four null hypotheses: the first three were that the observed probability would be significantly different from the expected probability of 100% for any of the three options. The fourth null hypothesis was that the responses would be equally distributed (33% for each response). Fisher-Exact test was used to assess the association between perspective (reason) and the chosen item. Hypothesis testing was performed at 5% level of significance. Procedurally, this study had 2 questions presented in a particular order with display logic based on the answer to the first question.

2.5. The Where's Waldo Study Methods

Statistical analysis (N = 407) was performed using R v 3.6.3. Counts and percentages were used to summarize categorical variables. Procedurally, this study had 5 questions presented in order as shown in the analysis.

2.6. The Financial Fish Study Methods

R v 3.6.3 was used to perform statistical analysis on the sample (N = 407). The distribution of categorical variables were summarized using percentages and counts. To summarize the distribution of continuous variables, the median and interquartile range were used. Researchers used the Wilcoxon signed-rank test. This study had 2 questions presented in order.

2.7. The P-Mapping Study Methods

The sample (N = 34,398) consisted of self-selecting software users. The data are from use patterns in the *Plectica Systems Mapping Software v1* (Plectica, New York, NY, USA) developed by Cabrera [123]. The data were collected from a self-service web application. The results provided herein are for the Perspectives pattern only, but the total collected data included all four DSRP patterns.

2.8. The P-STMI Study Methods

Data were collected from the *Systems Thinking and Metacognition Indicator (STMI)*. The indicator was developed by Cabrera and Cabrera [118]. The sample of subjects (N = 1059) was a "self-selecting sample of professionals between the ages of 18–65 who participated in beta version of STMI post-validation. Data were collected from a self-service web application that administers the STMI. Limited demographic data were collected. The data, which is on both competence and confidence measures, cuts across all four patterns of DSRP and "mix and match of DSRP patterns" [119]. The results provided in this publication are for only the Perspectives pattern. See [118] for more information on the data and findings.

2.9. The P-Fishtank Study Methods

Using a sample (N = 1750 baseline; N = 350 Post) that was generalizable to the US population, data were collected on all four DSRP patterns.For this manuscript, just the results on the Perspective pattern are reported. See [122] for a report of the wider data. This study had 2 questions separated by a treatment in a standard pre-post design. This order is presented in the analysis.
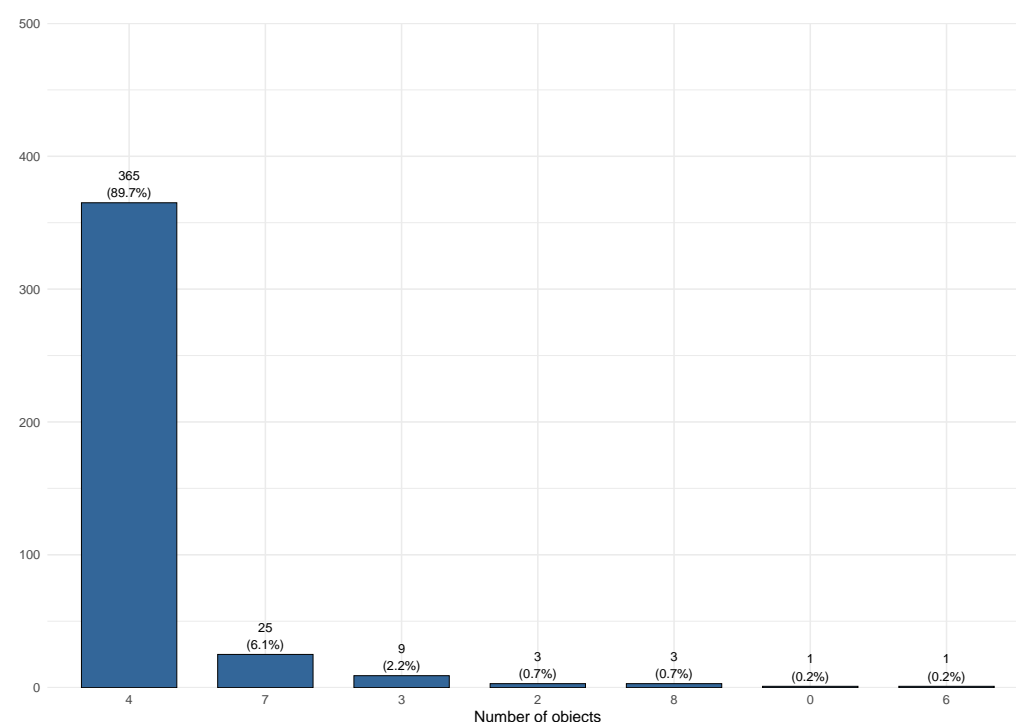
3. Results

3.1. The Only See Blue Study Results

Subjects were presented a hypothetical perspectival prime, "If you only see blue, how many objects are there?" (See Figure 3). This study determined if introducing a cognitive perspective would alter a simple object recognition and counting task. Our hypothesis was that, as a result of the perspectival prime, subjects would alter (by 3) the number of objects they actually see (7) and and therefore answer 4 (H_1 : 4). In effect, taking a cognitive perspective of someone who was color blind to the color orange. Thus, the null hypothesis was that subjects would see the number of objects that actually existed (7) (H_0 : 7).

If you only see blue, how many objects are there?
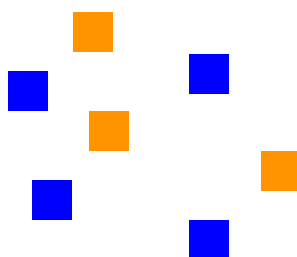
Figure 3. Only See Blue Study Task.

Figure 4 shows that the majority of the subjects observed four objects (89.7%), 6.1% reported seven objects, and 2.2% reported observing three objects.

Figure 4. Only See Blue Study Results.

Results in Table 4 for the goodness of fit show that the observed probability of choosing a number other than four was highly significantly different[3] from the expected probability of zero under the null hypothesis (X^2 = 357.06, $p < 0.001$ ***). Thus, the null hypothesis (H_0 : 7) was rejected and the alternative hypothesis (H_1 : 4) that a *perspectival* prime, would highly significantly determine subjects' responses—and therefore answer 4—is supported[4]. Sample size calculations were performed using G-Power, v 3.1.9.7, Heinrich-Heine-Universität

Düsseldorf, Germany and R v 3.6.3. A sample size of 196 respondents was needed to detect a small effect size (Cohens' w = 0.3) with 80% power at 5% level of significance. The effect size was estimated using Cramer's Phi. Crude odds ratio were also calculated as a measure of association. Cramer's Phi can be used as a measure of effect size for one dimensional data where the observed data are compared to expected values.
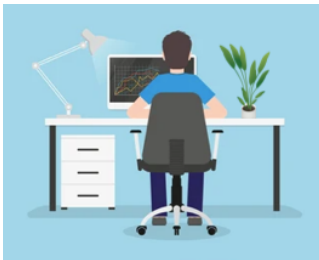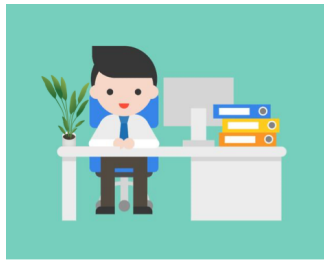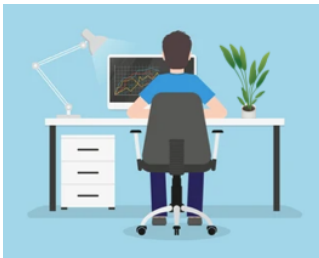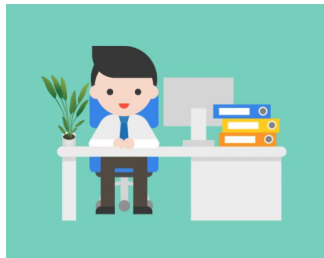
Table 4. Chi-square test for goodness of fit results.

Probability	Choose Four	Choose Other	X^2	p	Cramer' Phi	OR [95% CI]
Observed	365 (89.7%)	42 (10.3%)	357.06	**<0.001**	0.23	0.02 [0; 0.16]
Expected	407 (100%)	0 (0%)				

3.2. The Where's the Plant? Study Results

The *Where is the Plant?* study assessed the effects of certain aspects (alignment and anchoring) of perspective taking on answer choice. Alignment refers to whether the perspective of the "employee" was aligned with the perspective of the subject. Anchored refers to whether the task distinguished the plant in relation to the "employee" in the image or left it ambiguous. Table 5 shows the four tasks presented to subjects and their variables. All four combinations of these two variables were presented to all subjects. The order of the questions (and images), one at a time, was as follows: Not-anchored and Not-aligned; Not-anchored and Aligned; Not-aligned and Anchored; and, Anchored and Aligned.

Table 5. Four Combinations of Two Variables.

	Aligned	**Not-Aligned**
Anchored	The plant is ____ of the person.	The plant is ____ of the person.
Not-Anchored	The plant is ____.	The plant is ____.

All conditions had same answer choices: *to the right* or *to the left*.

The Null Hypothesis was $H_0 : \mu = 0$, or that there would be no effect of alignment or anchoring on answer choice. The Alternative Hypothesis was $H_1 : \mu > 0$, such that we would see an effect of alignment or anchoring on answer choice. The results in Figure 5 and subsequent statistical tests show that we can reject the null hypotheses and conclude that the null hypothesis is not true which shows the effect of alignment and anchoring on answer choice.

The task was completed by 407 subjects. Results showed that the proportion of subjects who chose 'to the right' was highest when the image was aligned whether it was anchored (93.1%) or not (94.3%) and lowest when the image was not aligned/not anchored (34.9%). Two-thirds of the subjects chose 'to the right' when the image was not-aligned but anchored (65.4%).
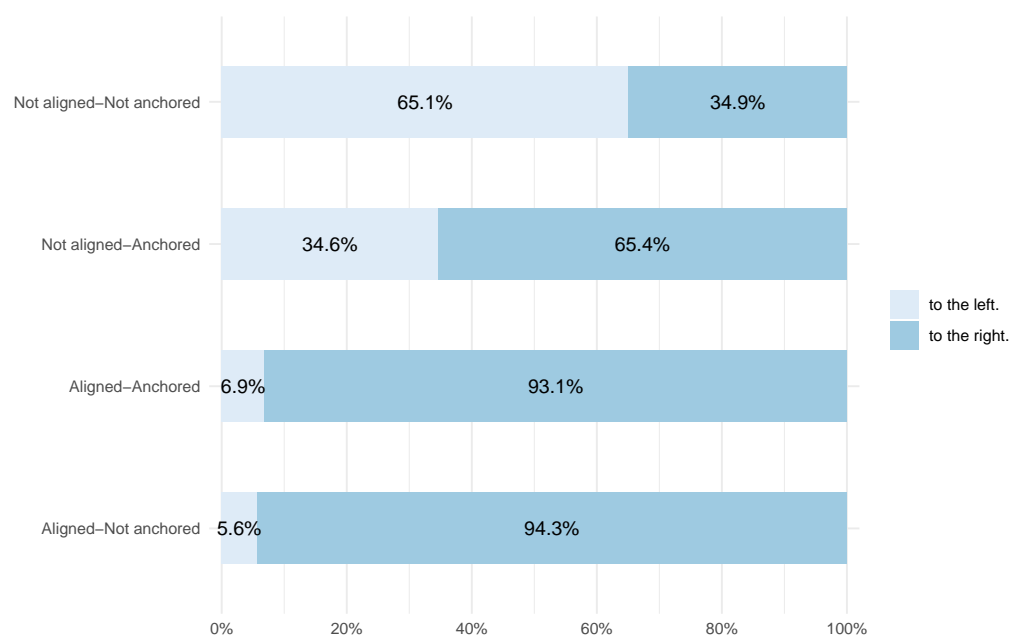
Figure 5. Proportion of correct answers in each of the four scenarios.

Results confirm (Table 6) that the probability of choosing right was significantly different from the probability of choosing left in all four scenarios ($p < 0.001$ *** for all comparisons). Sample size calculations were performed using G-Power and R v 3.6.3. Cramer's phi was used as a measure of effect size for Chi-square G test with the following cut-off values: (1) small 0.3, (2) medium 0.5, (3) and large 0.8. Cohen's g was used as a measure of effect size for pairwise comparisons with the following cut-off values: 0.00–0.05 Negligible, 0.10–0.15 Small, 0.20–0.25 Medium, and 0.25 or more Large. For Chi-square G test, a sample size of 196 respondents was needed to detect a small effect size (Cramer's Phi = 0.3) with 80% power at 5% level of significance. For McNemar's test, a sample size of 220 was needed to detect an effect size of 3 (OR = 3) assuming 20% disconcordant pairs, alpha of 0.005 to take into account multiple pairwise comparisons (N = 10) with 80% power.

Table 6. Chi-square G test results.

Condition	Null H	Alt. H	*PR*	*PL*	X^2	*p*	Cramer's Phi
Aligned/Not-anchored	pR = 100%	pR ≠ 100%	94.3%	5.6%	88.935	**<0.001**	**1 [Large]**
Aligned/Anchored	pR = 100%	pR ≠ 100%	93.1%	6.9%	142.12	**<0.001**	**1 [Large]**
Not-Aligned/Anchored	pL = pR	pL ≠ pR	65.4%	34.6%	38.391	**<0.001**	**1 [Large]**
Not-aligned/Not-Anchored	pL = pR	pL ≠ pR	34.9%	65.1%	37.172	**<0.001**	**1 [Large]**

Analysis was performed using Chi-square G test. The null hypothesis for each test is stated in the table. pR: Probability of choosing right. pL: Probability of choosing left.

Results also showed (Table 7) that the probability of choosing right was not associated with the anchoring of the person in the image when the person in the image was aligned with the subject ($p = 0.47$). All remaining pairwise comparisons were statistically significant ($p < 0.001$ ***). The anchoring was associated with the probability of choosing right or left when the person in the image was not aligned with the subject ($p < 0.001$ ***). This can be explained by the probability of choosing 'to the right' which was much higher when the image was Not-Aligned/Anchored (65.4%) which is much higher than when the image was Not-Aligned/Not-Anchored (34.9%). This indicates an interaction between anchoring and alignment.

Table 7. McNemar test results for pairwise comparisons.

Null Hypothesis	*p*	Crohen's g	OR [95% CI]
Aligned/Anchored ↔ Aligned/Not-Anchored = 0	0.47	0.08	15.64 [6.05; 40.47]
Aligned/Anchored ↔ Not-Aligned/Anchored = 0	**<0.001**	0.37	0.17 [0.04; 0.73]
Aligned/Anchored ↔ Not-Aligned/Not-Anchored = 0	**<0.001**	0.44	0.17 [0.07; 0.44]
Aligned/Not-Anchored ↔ Not-Aligned/Anchored = 0	**<0.001**	0.34	0.13 [0.03; 0.57]
Aligned/Not-Anchored ↔ Not-Aligned/Not-Anchored = 0	**<0.001**	0.45	0.51 [0.24; 1.1]
Not-Aligned/Anchored ↔ Not-aligned/Not-Anchored = 0	**<0.001**	0.36	3.64 [2.22; 5.98]

Analysis was performed using McNemar's test. P values were adjusted for false discovery rate. The null hypothesis for each comparison is that the difference in the proportion of correct answers is equal to zero.

Table 8 shows that the alignment was associated with the odds of choosing right (OR = 0.14, *p* < 0.001 ***) which indicates that the odds of choosing right were 86% lower when the person was not aligned compared to when the person was aligned. The anchoring was not significantly associated with the odds of choosing right (OR = 1.24, *p* > 0.05). However, the interaction between both terms was statistically significant (OR = 0.22, *p* < 0.001 ***). This indicates that the odds of choosing right is lower by 78% when the person is not aligned and not anchored compared to when the person is aligned and not anchored. The probability of choosing right is illustrated in Figure 6.

Table 8. Generalized linear mixed modelling analysis.

Predictors	Odds Ratios	CI	*p*
(Intercept)	14.22	9.46–21.36	**<0.001**
Alignment (Not-Aligned vs. Aligned)	0.14	0.09–0.21	**<0.001**
Anchoring (Not-Anchored vs. Anchored)	1.24	0.70–2.19	0.469
Alignment (Not aligned) * Anchoring (Not-anchored)	0.22	0.12–0.42	**<0.001**

CI: 95% confidence interval. Dependent variables: Choosing right.
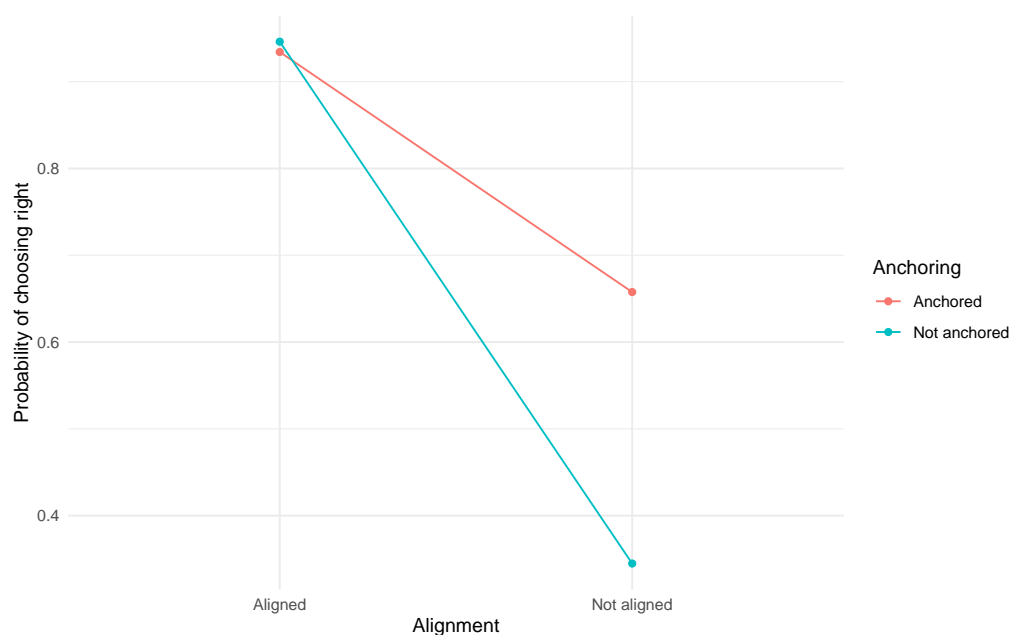
Figure 6. Effect of Alignment and Anchoring on Choice.

3.3. The What's a Bat? Study Results

The *What's a Bat?* Study assessed the effect of a perspectival scenario on how subjects perceived and named a common object (a baseball bat). Subjects were asked to complete three tasks presented one at a time, in the order shown in Table 9.

Table 9. Three Bat Study Tasks.

Scenario 1 (Baseline)	Scenario 2	Scenario 3
(no scenario)	You are being violently attacked in your home, you look around the room and see this:	You are lost in the woods and cold, you look around and see this:
What is it?	What is it?	What is it?

All scenarios had same answer choices: *Bat, Weapon, Firewood and Hat (distractor)* .

Results showed (Figure 7) that almost all respondents perceived the image as a bat (96.3%) in the baseline scenario. The responses varied for the remaining two situations that involved a specific scenario. In case of violent attack, slightly more than half of the respondents perceived the bat as a bat (53.8%) while less than half (44.5%) perceived it as a weapon (44.5%). In the third scenario, 61.2% of the respondents perceived the image as firewood and one-third (35.4%) perceived it as a bat (See Table 10).
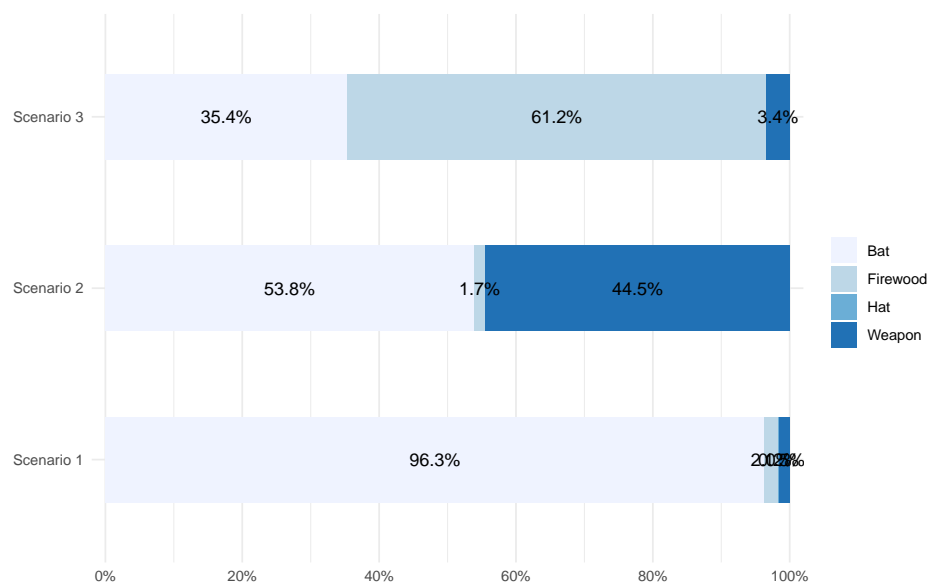
Figure 7. Distribution of responses based on the situation.

Table 10. Distribution of Responses Across Scenarios.

	Scenario 1	Scenario 2	Scenario 3
Bat	392 (96.3%)	219 (53.8%)	144 (35.4%)
Firewood	8 (1.97%)	7 (1.72%)	249 (61.2%)
Weapon	6 (1.47%)	181 (44.5%)	14 (3.44%)
Hat (distractor)	1 (0.25%)	0 (0%)	0 (0%)

Our hypothesis was that, as a result of the perspective born of the scenario, subjects would alter how they distinguished the object (image). Therefore, our null hypothesis, H_0, is shown in Equation (1) and our alternative hypothesis, H_1, is shown in Equation (2).

$$H_0 : \begin{cases} & \text{bat} & \text{hat} & \text{weapon} & \text{firewood} \\ 1 & 100\% & 0\% & 0\% & 0\% \\ 2 & 100\% & 0\% & 0\% & 0\% \\ 3 & 100\% & 0\% & 0\% & 0\% \end{cases} \qquad (1)$$

The alternative hypothesis was:

$$H_1 : \begin{cases} & \text{bat} & \text{hat} & \text{weapon} & \text{firewood} \\ 1 & 100\% & >0\% & >0\% & >0\% \\ 2 & \ll 100\% & 0\% & \gg 0\% & 0\% \\ 3 & \ll 100\% & 0\% & 0\% & \gg 0\% \end{cases} \qquad (2)$$

Results of the Chi-square test (Table 11) showed that the observed probabilities were significantly different from the expected probabilities under the null hypothesis in all three scenarios ($p < 0.001$ *** for all comparisons). Sample size calculations were performed using G-Power and R v 3.6.3. Cramer's phi was used as a measure of effect size for Chi-square G test with the following cut-off values: (1) small 0.3, (2) medium 0.5, (3) and large 0.8. A sample size of 196 respondents was needed to detect a small effect size (Cramer's Phi = 0.3) with 80% power at 5% level of significance. The odds ratio was used as a measure of association between the observed and the expected values under the null hypothesis.

Results of the multinomial logistic regression analysis showed (Table 12) that the odds of choosing firewood (compared to the odds of choosing the bat) were significantly higher in scenario 3 (lost) than scenario 1 (OR = 84.73, $p < 0.001$ ***). The odds of choosing a hat was significantly lower in Scenario 2 and 3 than Scenario 1. The odds of choosing a weapon were 54 and 6.35 times higher in Scenarios 2 (OR = 54, $p < 0.001$ ***) and 3 (OR = 6.35, $p < 0.001$ ***) than Scenario 1, respectively.

Table 11. Chi-square G test results.

Scenarios	Null H p (in %)	Alt H (in %)	X^2	p	OR [95% CI]	Phi
Scenario 1 (baseline)	100, 0, 0, 0	100, >0, >0, >0	219.85	**<0.001**	0.001 [0; 39]	1
Scenario 2 (Threat)	100, 0, 0, 0	≪100, 0, ≫0, 0	7775.9	**<0.001**	0.001 [0; 39]	1
Scenario 3 (Lost)	100, 0, 0, 0	≪100, 0, 0, ≫0	19922	**<0.001**	0.001 [0; 39]	1

Null H and Alternative H values for Bat, Hat, Weapon, Firewood (in that order). Analysis was performed using Chi-square G test. The null hypothesis for each test is stated in the table. Null H p: Expected probability under the null hypothesis.

Table 12. Multinomial logistic regression analysis.

	Firewood		Hat		Weapon	
Predictors	Odds Ratios	p	Odds Ratios	p	Odds Ratios	p
(Intercept)	0.02 (0.01–0.04)	**<0.001**	0.00 (0.00–0.02)		0.02 (0.01–0.03)	
Scenario 2 vs. Scenario 1	1.57 (0.56–4.38)	0.392	0.00 (0.00–0.00)	**<0.001**	54.00 (23.55–123.83)	**<0.001**
Scenario 3 vs. Scenario 1	84.73 (40.85–175.72)	**<0.001**	0.00 (0.00–0.00)	**<0.001**	6.35 (2.40–16.84)	**<0.001**

3.4. The Ball-Dot-Hole Study Results

The Ball-Dot-Hole study was a two-step task where the second task was dependent on the subject's answer to the first. The first task is to describe what is seen when shown an image and answer if it is a ball, dot or hole. Then, depending on their answer they were asked a follow up: Why not [answer not chosen 1] or [answer not chosen 2]?

Our null hypothesis was that perspective would not affect subjects' choice; that shown a circle and given three choices to describe what they see (Ball, Dot, or Hole) they would all make the same choice because a circle is a *natural kind* that all people would see the same way. Thus, our null hypothesis, as shown in Equation (3) is H_0 : 100% ∨ 100% ∨ 100% for the the first task (Q1), where and ∨ means OR. A second *dependent* question asks them the *reason* they did not choose the other two options. Thus, our null hypothesis for the second task (Q2) was H_0 : 1 ∨ 1 ∨ 1. If perspective was not a factor, everyone would see the object the same way and have the same unitary *reason* for doing so.

$$H_0 : \begin{cases} & \text{ball} & \vee & \text{dot} & \vee & \text{hole} \\ Q1 & 100\% & \vee & 100\% & \vee & 100\% \\ Q2 & 1 & \vee & 1 & \vee & 1 \end{cases} \tag{3}$$

Our alternative hypothesis for Q1 was H_1 :< 100%∧ < 100%∧ < 100%, ∧ means AND. For Q2 H_1 :> 1∧ > 1∧ > 1 as shown in Equation (4). This is because we expect that perspective *will* effect answer choice, so in Q1 *answers will vary* and in Q2 *reasons will vary*.

$$H_1 : \begin{cases} & \text{ball} & \wedge & \text{dot} & \wedge & \text{hole} \\ Q1 & < 100\% & \wedge & < 100\% & \wedge & < 100\% \\ Q2 & > 1 & \wedge & > 1 & \wedge & > 1 \end{cases} \tag{4}$$

Figure 8 shows that the majority of the respondents (60.7%) chose "ball" while 34.9% and 4.4% chose hole, and circle, respectively.
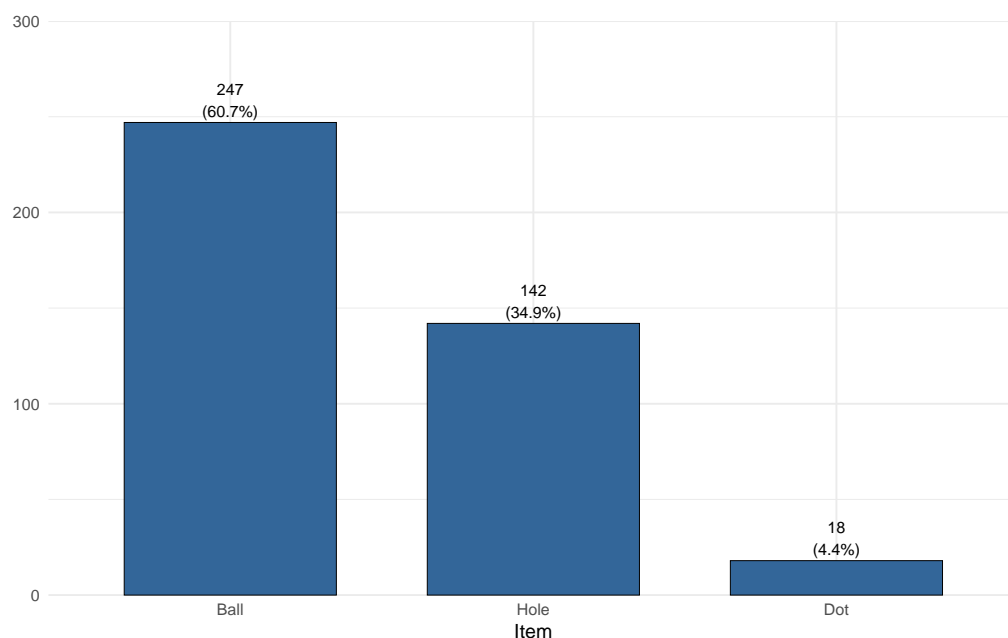
Figure 8. Distribution of responses to Ball-Dot-Hole Task.

Results (Table 13) show that the probability of observing either the ball, dot, or hole was lower than 100% for all three choices ($p < 0.001$ *** for the three comparisons). Moreover, the observed probability for three items was significantly different ($p < 0.001$ ***) from the expected equal distribution (33% for each item). Null H1, H2, and H3, for example, tested whether ball, dot, or hole was equal to 100%, respectively. H4, tested whether the

proportions were equal for all three options. Alt H1, H2, and H3, tested whether any of them was <100%. Whereas Alt. H4 tested whether the proportions were not equal. Thus, the *p*-value will be <0.05 if the observed probability for any of these three options is not equal to 33%. Sample size calculations were performed using G-Power and R v 3.6.3. Cramer's phi was used as a measure of effect size for Chi-square G test with the following cut-off values: (1) small 0.3, (2) medium 0.5, (3) and large 0.8. A sample size of 196 respondents was needed to detect a small effect size (Cramer's Phi = 0.3) with 80% power at 5% level of significance.

Table 13. Chi-square G test results for Ball-Dot-Hole Tasks.

	Hypothesis 1 *Ball, Dot, Hole*	**Hypothesis 2** *Ball, Dot, Hole*	**Hypothesis 3** *Ball, Dot, Hole*	**Hypothesis 4** *Ball, Dot, Hole*
H_0	100% ∨ 100% ∨ 100% *Which translates into three null hypothesis:* 100%, 0%, 0%	0%, 100%, 0%	0%, 0%, 100%	P1 = P2 = P3 33%, 33%, 33%
H_1	<100% ∧ <100% ∧ <100%			P1 ≠ 33%, P2 ≠ 33%, P3 ≠ 33%
X^2	4780	19538	14713	193.71
p	**<0.001**	**<0.001**	**<0.001**	**<0.001**
Phi	**1**	**1**	**1**	**0.69**

Analysis was performed using Chi-square G test. The null hypothesis for each test is stated in the table. Null H p: Expected probability under the null hypothesis. ∨: OR. ∧: AND.

When asked a follow up question—"Why didn't you choose [the other options]?"—results (Figure 9) showed that 72.7% of subjects whose reason was coded as 'boundary' chose hole than ball or dot. Whereas, subjects whose reason was coded as 'size' and 'superficial' chose ball.
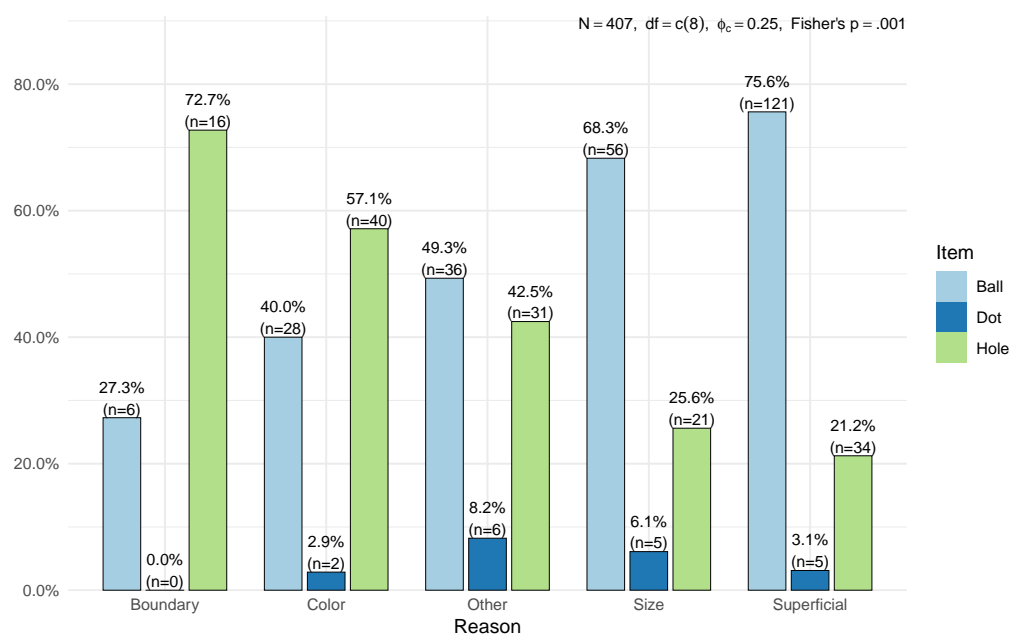
Figure 9. Frequency of Ball-Dot-Hole Choice for Stated Reason.

Results (Figure 10) show that the most common reason for choosing ball was the coded group 'superficial' while the most common reasons for choosing dot and hole were 'other' and 'color'.
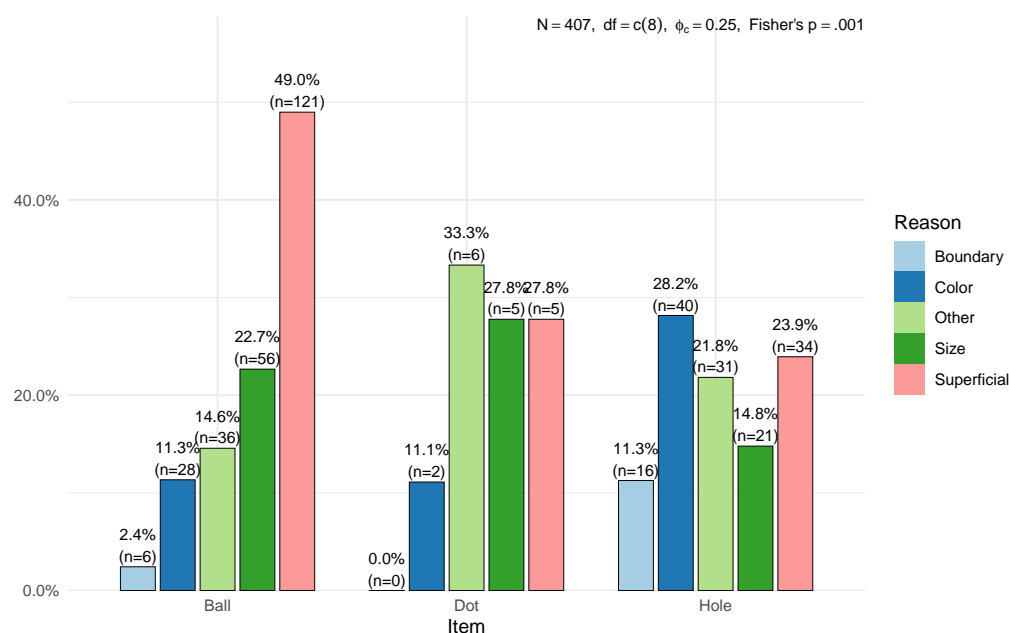
Figure 10. Frequency of Stated Reason for Ball-Dot-Hole Choice.

3.5. The Where's Waldo Study Results

The *Where's Waldo study* aimed to determine if perspective taking was a factor in a common cognitive process: searching for and identifying a known item amongst other items. The alternative hypothesis was that perspective taking is an essential element of this search process. This is similar to the Where's Waldo game.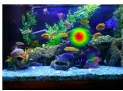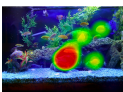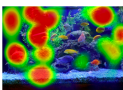 At first you do not even know what Waldo is, but once you have a concept of what Waldo looks like 🧑‍🦰, you can search a complex landscape to find him. During search, you *hold an image of Waldo in your mind* that acts as a *perspectival filter* that distinguishes and filters out anything that is not-Waldo. Interestingly, this *image-ined perspectival filter* requires a composite *image*-ined image of Waldo and his various parts (his striped hat, goofy face, scarf, etc.). Thus, the alternative hypothesis was $H_1 :> 0$. This is because we expect that perspective *will* affect subjects' ability to search, find, and identify (by clicking and labeling) an item in a backdrop of items.

If this form of conceptual-perspectival-filtering *did not* exist, then asking subjects to search and find items they did not otherwise see would not work. Therefore, the null hypothesis was that perspective filtering would have no effect on search ($H_0 : 0$). If they did not see the item the first time, they would not see it the second time. In numerous previous tests during a baseline study (N = 1510) subjects were asked to describe what they see and shown a fishtank. In thousands of responses, not one ($H_0 := 0$) subject identified the [somewhat prominent] red-and-green-plant in the left lower area of the aquarium, the filter (existing in multiple places), eyeballs, fish livers, or negated items (not-sand, not-rocks, etc.). Thus, the alternative hypothesis was that subjects would countervail this trend and see the items they had not previously seen (thus $H_1 :> 0$).

Subjects were shown an image of a fishtank and asked to "Click on the _____ and label it," where the blank was a host of perspectival prompts: 'the red and green plant,' 'filter,' 'eyeball,' 'liver,' 'not-sand, etc.' Summary results are shown in Table 14.

Table 14 and Figure 11 show that the majority of subjects completed the 5 tasks correctly. Notably, only 57.2% of the respondents correctly completed the negative-task to identify NOT fish, gravel, rock, coral, vase, or plant.

Table 14. Descriptive Statistics and Fishtank Heatmaps for the Where's Waldo Study Tasks.

Heatmap	Task	Clicked	% Total	Stats
	Click on the 'red and green plant'	Correct Incorrect	81.48% 18.51%	M = 0.81, SD = 0.39, CI = 99%, N = 405
	Click on the 'filter'	Correct Incorrect	85.50% 14.49%	M = 0.86, SD = 0.35, CI = 99%, N = 407
	Click on the 'eyeball'	Correct Incorrect	92.13% 7.86%	M = 0.92, SD = 0.27, CI = 99%, N = 407
	Click on the 'liver'	Correct Incorrect	88.20% 11.79%	M = 0.88, SD = 0.32, CI = 99%, N = 407
	Click 'NOT fish, gravel, rock, coral, vase, plant'	Correct Incorrect	57.24% 42.75%	M = 0.57, SD = 0.50, CI = 98%, N = 407
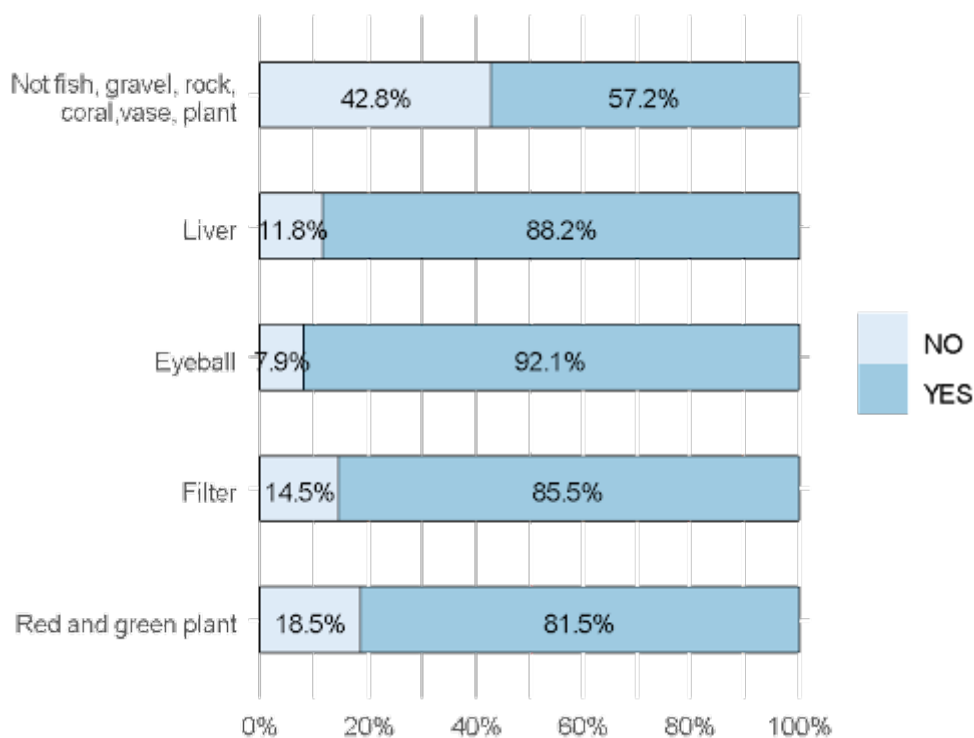
Figure 11. Fishtank Heatmaps for the Where's Waldo Study Tasks.

3.6. The Financial Fish Study Results

Two tasks were used to better understand animate and conceptual perspectives. Put simply, an *animate* perspective is a perspective taken for a "thing with eyes" (e.g., a frog, animal, person, giraffe, etc.). A *conceptual* perspective is a perspective taken from the point of view of a concept (e.g., as in the 14 systems engineering perspectives: economic, technological, historical, social, health and safety, political, emotional, moral/ethical, security, ecological, cultural, legal, organizational). DSRP Theory predicts any thing (which is every thing) is, and can be, a point of view. The results are shown in Table 15 for *n* > 1.

Table 15. Animate and Conceptual Perspectives WordCloud Results.

Describe what you see, from the perspective of a fish...	Describe what you see, from a financial perspective...
(an animate perspective)	*(a conceptual perspective)*

Analysis was restricted to only coded-correct words ($n > 1$) from animate (fish) and conceptual (financial) perspectives.

Data in Figure 12 show that 206 (52.5%) subjects did not take a discernible[5], animate, *fish-like* perspective. A total of 115 (29.3%) took a fish-like perspective on one and 46 (11.7%) on two objects from an animate perspective. A total of 186 respondents chose at least one object from an animate fish-like perspective. Subjects identified a total of 309 words from a discernible, animate, fish-like perspective.
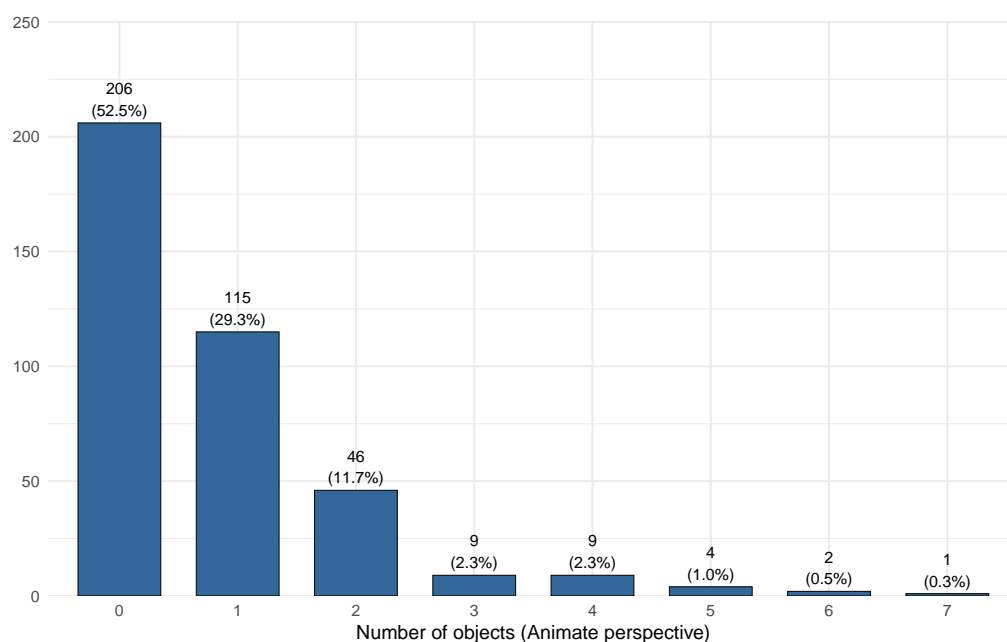
Figure 12. Number of correct objects chosen from an animate perspective (N = 392).

Figure 13 shows the number of objects (words) coded as identifying a discernible, animate, fish-like perspective. Analysis was restricted to only coded-correct words ($n > 5$) from an animate (fish-like) perspective.

Figure 14 shows that a total of 133 (38.7%) subjects did not take a discernible, conceptual, *financial* perspective, and 211 did.
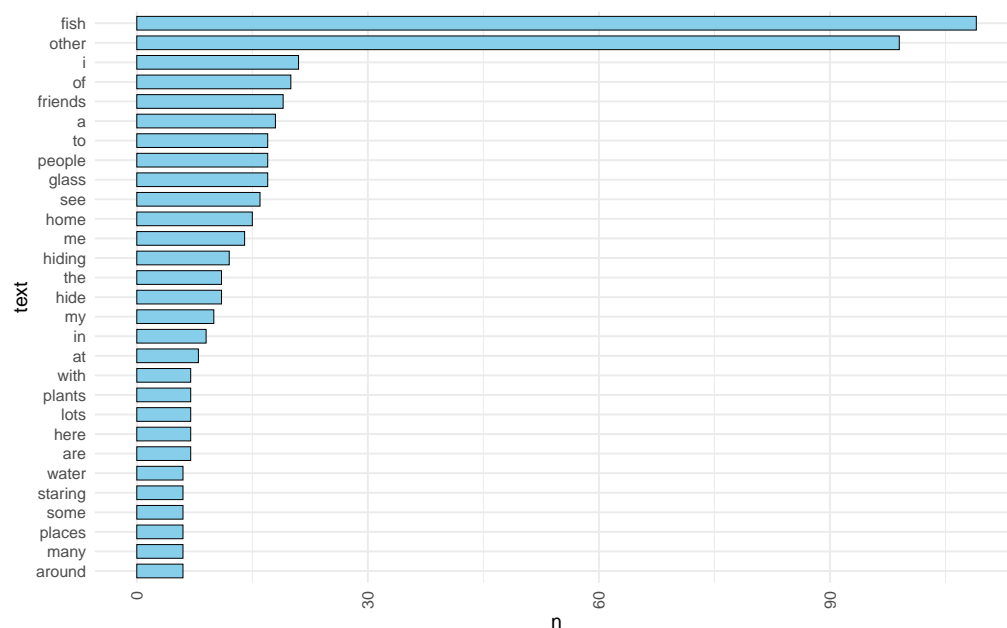
Figure 13. Objects identified from an animate perspective ($n > 5$).
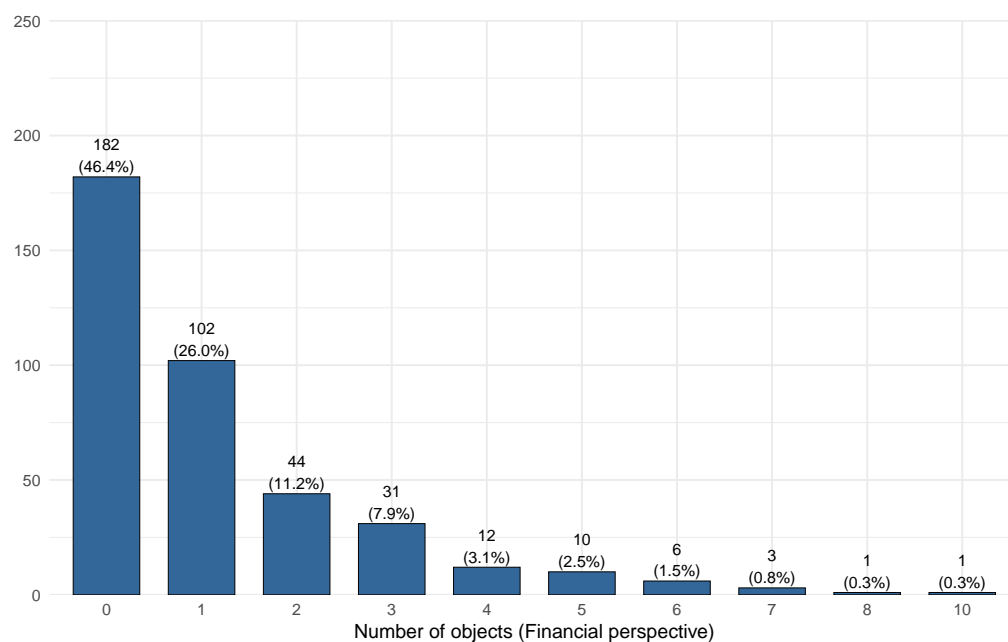
Figure 14. Number of correct words from a financial perspective (N = 344).

Figure 15 shows a total of 457 words were identified by 322 subjects from the financial perspective, which is higher than the 309 words identified when the animate perspective was used, although the number of respondents was lower in the latter case (N = 344).

A comparative analysis was performed on the median number of coded-correct words identified in both situations (animate (fish) and conceptual (financial). The analysis was restricted only to subjects (N = 340) who chose at least one word in both situations. Analysis using Wilcoxon signed-rank test shows (Figure 16) that the median number of words was higher when the conceptual perspective was used (M = 1, IQR [1–2]) than when an animate perspective was used (M = 1, IQR [0–2]) and the difference was statistically significant ($p < 0.001$ **).
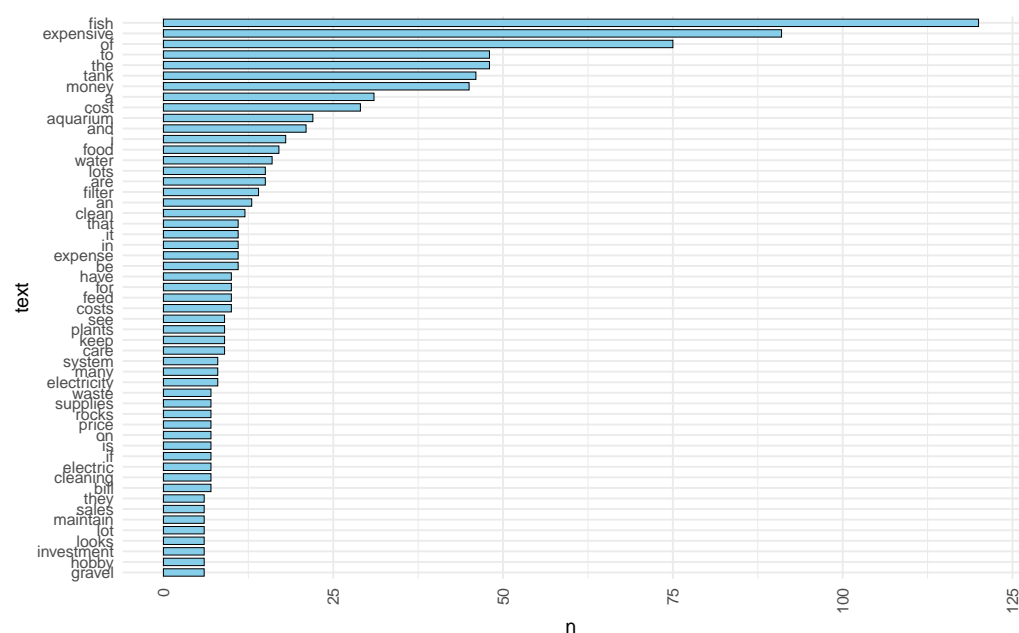
Figure 15. Objects identified from an animate perspective (*n* > 5).
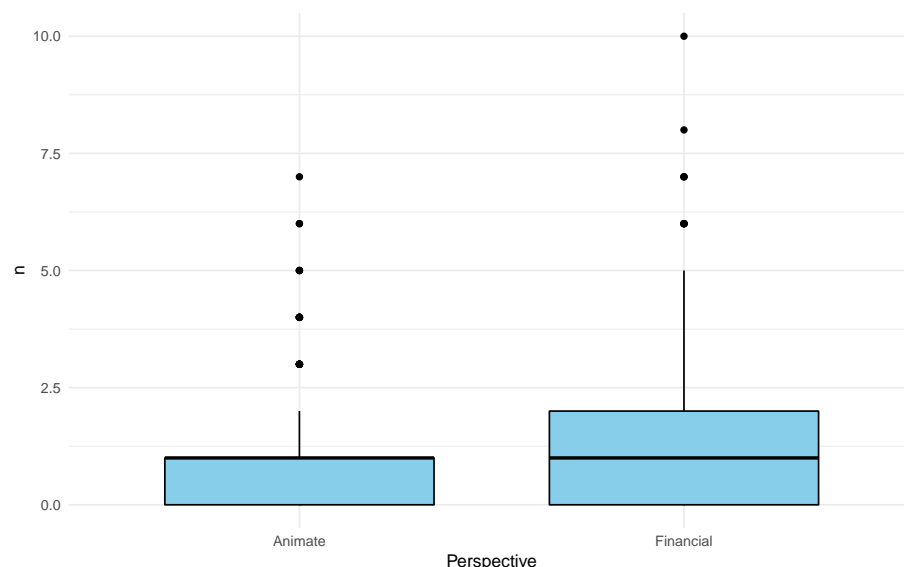
Figure 16. Distribution of the number of perspectival words.

Generalized linear mixed modeling (mixed ordinal logistic regression) shows in Table 16 that the odds of choosing a conceptual perspective are 2.29 times higher than the odds of choosing animate perspective (OR = 2.29, $p < 0.001$ **). Although this was not part of the original hypotheses, it is counter to anecdotal experience and therefore unexpected.

Table 16. Mixed ordinal logistic regression analysis results.

Predictors	Odds Ratios	CI	*p*
class [conceptual (financial) vs. animate (fish)]	2.29	1.69–3.10	**<0.001**

Results also showed (Table 17) that the proportion of subjects who identified at least one correct answer was significantly higher when the conceptual perspective was used ($X^2 = 13.67$, $p < 0.001$ **). Sample size calculations were performed using G-Power. A sample

size of 220 was needed to detect an effect size of 3 (OR = 3) assuming 20% disconcordant pairs, alpha of 0.005 to take into account multiple pairwise comparisons (N = 10) with 80% power. Effect size was calculated using Cohen's g.

Table 17. Comparison of correct answers between animate and conceptual perspectives.

Predictors	nc	nic	X^2	p	Cohen's g	OR [95% CI]
Animate	186 (47.4%)	206 (52.6%)	13.67	**<0.001**	**0.41 [0.39–0.42]**	**0.06 [0.04–0.08]**
Conceptual	211 (61.3%)	133 (38.7%)				

nc: Number of subjects with 1 or more correct answers. nic: Number of subjects with no correct answers.

3.7. The P-Mapping Study Results

A study (N = 34,398) determined what people do (and do not do) when they map a system using aggregate data of software users in Plectica[6], a systems mapping software. Aggregate data were analyzed based on individual maps for structure only. If a structure was used, it was counted. In other words, each action represented by a click or movement in the map was accounted for across all maps. These data were then analyzed to determine the proportion for each type of action across maps. Cabrera [119] demonstrated that, "48% did *nothing*, which is consistent with case study research where people faced with an open-ended problem or question (mapping prompt) and/or a blank page or screen (mapping area) had no response and took no action (i.e., they 'froze')". 52% of people in the study made 2,066,654 *identity* distinctions. 48% of people broke down their distinctions into 769,120 parts. 46% of people made 565,999 relationships between things. 25% of people distinguished 87,318 relationships by adding an identity (naming) the relational line. 16% of people took at least one explicit perspective (39,398 perspectives taken). 4% of people distinguished 16,668 perspectives. 2% of people included 3,265 relationships in the view of their perspective as shown in Table 18.

Table 18. Actions Users Take and Do Not Take When Systems Mapping (N = 34,398).

Percentages	Action Taken	Number
48% (N = 16,516)	distinguished nothing (i.e., did not think)	0 times
52% (N = 17,882)	distinguished things	2,066,654 times
of those 48%	broke down their distinctions into parts	769,120 times
of those 46%	related things	565,999 times
of those 25%	distinguished their relationships	87,318 times
of those 16%	took at least one perspective	39,398 times
of those 4%	distinguished their perspective taking	16,668 times

These data provide insight into both what people do not do and what they do when mapping using systems thinking. Table 19 differentiates between what people do (or did) and what they did not do (or could or should do). The table is a good baseline for what systems thinkers should do more of and what they should continue to do.

Specifically, less than half of people will make Relationships (46% of people related identities 565,999 times). Only 25% of people distinguished their relationships and only 87,318 times; or zoom into them and add parts (*RDS*) or relate the parts of the whole ($p \overset{R}{\Longleftrightarrow} p$). People will look for the *direct* cause (*R*), but rarely think in webs of causality (*S* of *R*s). Where Relationships are concerned, as a metacognitive skill, two jigs—"Part Parties" [124] and "RDSs" [125]—can be used to dramatically increase cognitive complexity and efficacy in systems thinking.

Table 19. What People Do and Do Not Do in Systems Mapping (N = 34,398) [119].

What People Tend to Do	What People Tend Not to Do
Make identities (D^i)	Rarely consider the other (D_o)
	Rarely challenge or validate the identities (D_o^i) they make
Make part-whole systems (S_w^p)	Rarely challenge the way, or consider alternative ways, that parts are organized into wholes ($S(P)$)
	Rarely think +1 and −1 from the level they are thinking about ($w = p$ or $p = w$)
	Rarely relate the parts of the whole ($p \overset{R}{\Longleftrightarrow} p$)
Occasionally relate things (R)	Almost never distinguish their relationships (RD) or zoom into them and add parts (RDS)
	Sometimes look for the *direct* cause (R), but rarely think in webs of causality (S of Rs)
Take only their own perspective (P) [implicitly]	Almost never take explicit perspectives (P_v^ρ)
	Rarely take multiple perspectives ($n \times P_v^\rho$)
	Rarely take conceptual perspectives (C_ρ)

3.8. The P-STMI Study Results

Using data collected from the Systems Thinking and Metacognition Indicator (STMI) [118] Study, subjects (N = 1059) showed evidence of the Dunning-Kruger Effect [126], where, in the point-view Perspectives (P) skill, confidence was higher than competence, as demonstrated in Figure 17. In identity-other Distinctions, part-whole Systems, action-reaction Relationships, and point-view Perspectives (the four universals of DSRP theory), the Dunning-Kruger Effect was present. For this publication we highlight the results for only point-view Perspectives. Subjects' aggregate point-view Perspectives Confidence score was 83.5 while their competency/skill score was 57—a difference of 26.5. The point-view Perspectives universal was where the Dunning-Kruger effect was *highest*.
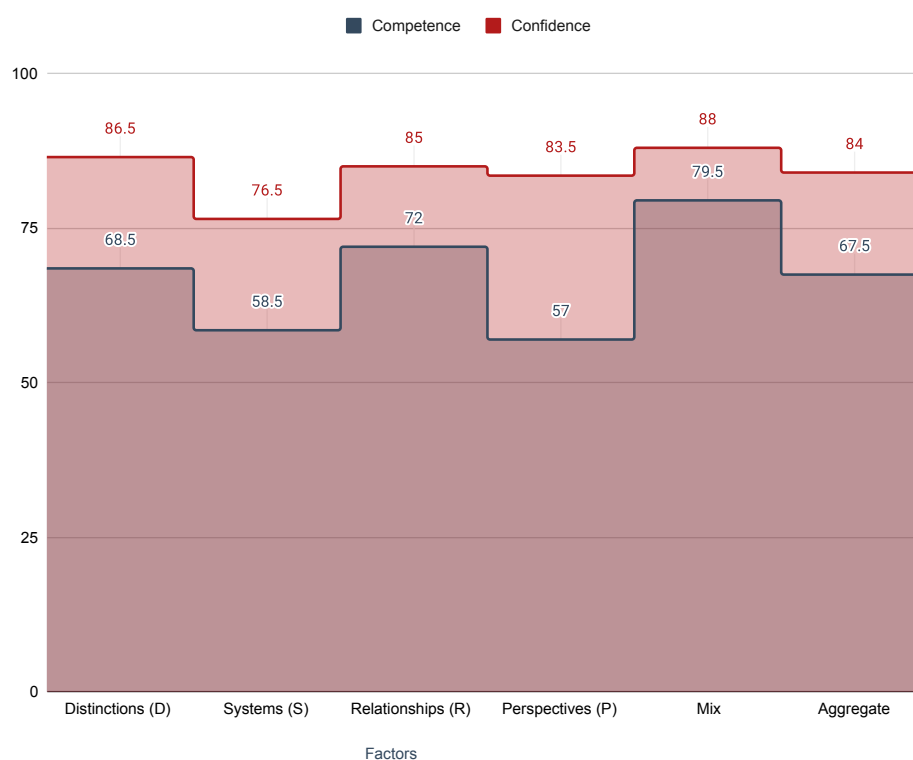
Figure 17. Dunning-Kruger Effect in point-view Perspectives [119].

3.9. The P-Fishtank Study Results

In the P-Fishtank study [122], there were two conditions: PreP (Pre-Perspectives-prime) and PostP (Post-Perspectives-prime). The results from the study are shown quantitatively, qualitatively and visually in a wordcloud: the differences between the word clouds generated for PreP and PostP are shown in Table 20.

Table 20. Word Cloud of Response Before and After Perspective Prompt.

PreP	PostP
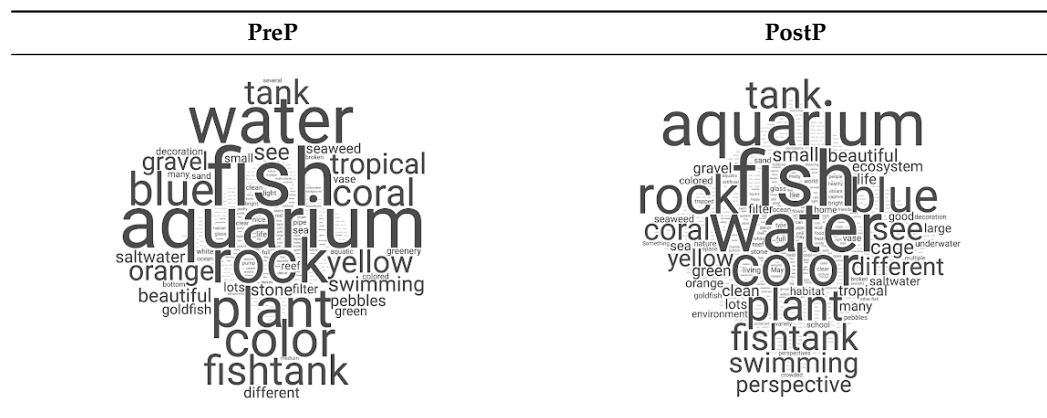
The significance of the Perspectives prime is shown in the word clouds. The PostP word cloud has more detail and more descriptive words than the unprimed PreP cloud. In the word cloud images, the larger a word is, the more frequently it is used. Words such as "perspectives" and "see" demonstrate that the subjects were operating from a perspectival mental model. These words were not present in the PreP data. There are more unique words overall in the PostP condition. The quantitative data reflects these same patterns: the responses in the PostP data have more words overall and they are more perspectival. Table 21 shows the quantitative data analysis.

Table 21. PreP and PostP Aggregate Response Data [122].

	PreP	PostP	Difference
Number of characters (including spaces)	19,758	22,371	+11.68%
Number of characters (without spaces)	12,336	13,794	+10.57%
Number of words (including repeated words)	2513	2915	+13.79%
Number of syllables (including repeated words)	3967	4483	+11.51%
Unique words	276	497	+44.47%
Number of characters (no spaces) for Unique Words	1598	2914	+45.16%
Number of syllables for Unique Words	533	991	+46.22%
Total Unique Word Occurrence	2089	2322	+10.03%

A less than one-minute treatment of the P-rule led respondents (*with statistical significance*) to increased the cognitive complexity of what they saw in a scene and how they described it. Figure 18 shows two [of several] of the dimensions where subjects increased the cognitive complexity of responses with highly statistically significant results. Lewis and Frank [127] showed that the length of words reflects their conceptual complexity. For a more detailed explanation of this study, see [122].
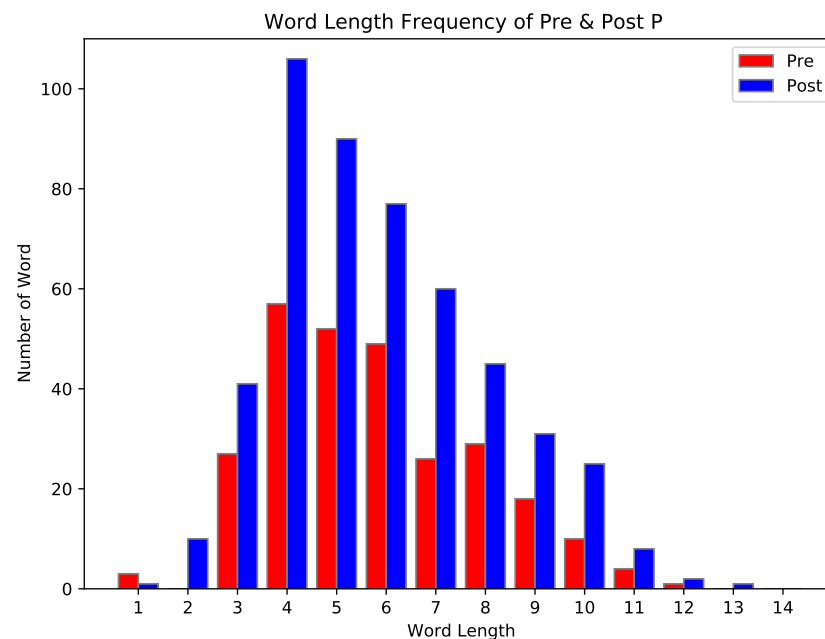
Figure 18. Increased Cognitive Complexity of Response After <1 min Treatment of P-Rule [122].

4. Discussion of Findings

Across 6 studies, all with high statistical validity, the *Only See Blue, Where's the Plant?,* *What's a Bat?, Ball-Dot-Hole, Where's Waldo?,* and *Financial Fish* studies all support the existence of Perspective universally. These studies support that the point and view are separate variables and can be manipulated with transformative effect. They collectively show the mutual dependencies between P and D, S, R. They show that any object, concept, or thing can be a perspective *point* or part of a perspectives *view* based on the observes/observing relationship. These studies, along with the *P-Mapping, P-STMI,* and *P-Fishtank* show that P-rule, as a metacognitive skill, has high efficacy with low investment.

4.1. Only See Blue Study Findings

This research shows with highly statistically significant results ($p < 0.001$ ***) that a simple perspectival prime can dramatically effect the results of cognition and how reality is perceived. The perspectival prime itself is comprised of two elements, a *point* ("if you only see blue") and a *view* (a request to recognize and count the number of objects that exist). Seven objects exist, but a majority of subjects only identify four. Interestingly, this could be perceived to defy the observable fact that there are 7 objects. Yet, subjects needed no training whatsoever in order to easily "take a perspective" that dramatically alters their worldview, indicating that perspective taking is an innate cognitive function. Note also that in order to formulate this "perspective" at least two elements are required: point and view. However, also that there must be an observer and observed relationship between point and view. The subject needed to assume the role of an observer who could only see blue. They themselves could see orange, but the perspective made it as if they effectively could not. Under this new perspectival regime, the task was relatively easy: 4 objects. The view is the objects. The point is the prompt. The prompt is a conceptual observer who only sees blue and therefore does not see orange. Distinctions need to be made. The Perspective itself is a part-whole System (point and review related) which includes the necessity of a Relationship. Note also that the prime effected individuals at their own psychological level of cognition. However, it also affected the social cognition (the statistical sum of individual cognitions). Thus, we can speak of individual's perspectives but also about the group's collective perspective.

An alternative explanation is that because the instructions for the task ("If you only see blue, how many objects are there?") are ambiguous, subjects are attempting to interpret

the researcher's instructions and answering accordingly. In this alternative explanation, subjects could interpret "are there" as "how many are observed by people who only see blue" or alternatively as "how many actually exist independent of observers". This explanation does not really hold, but curiously, even if it did, the results would be the same. The reason it does not hold is that the overwhelming majority of subjects (89.7%) chose four. Thus, for the overwhelming majority of subjects the question was not ambiguous. Nevertheless, let us assume that the results are the effect of question ambiguity. Regardless, the numbers will be the same and the interpretation will remain the same because the whole point is that subjects will take different perspectives when answering the question—this is the only conclusion that explains both the 89.7% (who chose four) and the 6.1% (who chose seven) and even the 2.2% (who chose nine), etc.

Now consider an alternative to this alternative: what if *all* instructions are ambiguous because perspective is at play universally? That is, what if the interpreting effects we see in all instructions are a function of the perspectival nature of construct formation and therefore construct validity? Another way of saying this is that there are *no unambiguous instructions*. There is universally a perspective and therefore there is always room for interpretation. This is precisely why the question (instructions) were designed to be purposefully ambiguous. To isolate that perspective exists and is universally at play. The same alternative analysis can be applied to the purposeful ambiguities of the instructions in the *Where's the Plant?* study.

4.2. The Where's the Plant? Study Findings

The results of the Where's the Plant Study provide us with a number of interesting findings. First, that there is always (universally) a "root perspective". In this case the root perspective is the perspective of the subject. The root perspective can be in alignment with an alternative perspective (blue images) or not (green images). The direction (left or right) of the plant is entirely relative because left and right are entirely relative. Indeed, the plant could be left and right relative to the edge of the desk, or relative to any other point or object in the scene. Thus, in the four task conditions, there is no "correct or incorrect" answer. Therefore, we are measuring the degree of difference between answers as a proxy for the difficulty or ambiguity of the task. It is clear (with high statistical significance) that the least ambiguous or easiest tasks are when there is alignment between perspectives. Alternatively, the most difficult or most ambiguous tasks are when there is not alignment between the root and alternative perspectives. Said simply, it is easy to agree with people when they agree with us. Or said another way, perspectives different from our own are harder to see, even when we are prompted to see them (as in the anchored cases). Or, we could also conclude that there is more ambiguity when perspective is out of alignment.

Thus, the birth of popular sayings such as: 'sharing the same perspective'; 'being on the same page'; 'thinking in the same way'; 'seeing things with the same eyes'; 'having the same outlook or position'; 'thinking in the same way'; 'multiple people having the same understanding'; 'sharing the same information or knowledge'; 'everyone is in agreement'; 'thinking in the same way'. *All* of which are meant to communicate the aligning of perspectives with one another to increase communication, effectiveness, teamwork, etc.

Note how many of these commonly used statements are 'metaphors we live by', as Lakoff explains [128]. They are all deeply rooted in the metaphor of sharing the same physical position and therefore the same positional perspective (as was tested in the study), using terms like: in, being, same, place, position, way, seeing, outlook, eyes, same, share. Thus, there is ambiguity when perspectives are out of alignment, which this study clearly shows.

Of course these results also show that when you're in a root perspective, there is a certain lock-in to being in it; and also associated difficulty (or escape velocity needed) to get out of it and see a different perspective. The findings show that it is easy to take an alternative perspective when it is in alignment with your own. However, they show us that the reverse is also the case, it is hard to take another perspective when it is not in alignment with your own. More effort, attention, motivation, desire, metacognition will be required.

Of course, the Where's the Plant Study also makes it clear that perspective is universal and therefore is easy to *educe*. Whats more, it is clear that there is a point and a view variable in any given scenario or situation; indeed that there actually are several of each and a multitude more possible. We could have asked where the plant is from the perspective of the arm of the chair, edge of the desk, another work colleague, a group of work colleagues, the air molecules in the room, or any point anywhere in the universe. All of which would yield different mental models to determine and all of which would involve taking multiple perspectives simultaneously. Likewise, we see that the perspectives themselves need not be 'human' or 'have eyes.' They could be conceptual or physical, etc. We see that perspective is a mind-bending, and shape-shifting act, that allows the perspective-taker to travel long distances to impossible places and arrive at commonly shared and reasonable answers. We also therefore see the individual cognition and social cognition at play: that although we differ in the perspectives we take, there is a pattern to our taking them both structurally and informationally.

Although we do not think it would change the essential results of the study, one future adjustment that should be made to this study is that the order of presentation should be counterbalanced. Although subjects were not allowed to adjust previous answers, all subjects did receive the questions in the same order. Thus, although counterbalancing should be done in future studies, we propose that the universality and level of sensitivity to perspective (extremely high and universal) is far grater than the universality and sensitivity to order of operations (relatively low and not universal). Ironically, the very concern (and subsequent critique) of biasing based on order of operations (that requires counterbalancing) only *reinforces* the universality of perspective. This is because the valid concern is that in an ordered set including item A and item B, if A is first, it will influence or perspectively prime B and vice versa. Thus, critics can either have their cake or eat their cake, but they cannot have and eat their cake. Either perspective is universally shown in the study's results, or their concern for the study's design is an indication of their concern for the universality of perspective. The same concerns, critique and explanation applies to the *What is a Bat?* and *Ball-Dot-Hole* studies.

4.3. The What's a Bat? Study Findings

What is a Bat? Well, it depends on the situation, and the situation alters one's perspective. The baseline Scenario 1 (See Table 9) shows that 96.3% of people see the object as a bat. However, given the perspective-changing scenario of a violent attack, 44.5% changed how they perceived the object and saw it as a weapon. Interestingly, because a bat itself could be a weapon that's far less than the 61.2% of people who saw the object as firewood in Scenario 3 where they were lost and cold in the woods.

The highly statistically significant results of this study tells us a few things. First, perspectives exist, even when identifying (Distinguishing) an object as simple as a baseball bat. Second, our perspective can be dynamically altered by the situation. A bat is not a bat is not a bat. Third, the *point-view* elements of Perspective are dynamical and changing either the point, view, or both, can change the Perspective. In this study, the situation changed the *point*, and the *view* also changed as a result. Fourth, this study shows (confirmed by other studies) that these various possible views of an object can become an *attributional* and *relational* part-whole structure where a concept or object can 'possess' multiple parts (i.e., object = {bat, weapon, wood, firewood, stick, etc.}). This part-whole structure (a function of the relational attributes born of perspective) creates a massively interconnected and fluid "set of sets" that can then be used to be creative, innovative or inventive (e.g., use a bat as a weapon or as firewood or as a the pole for a tarpaulin). Finally, we again see the individual cognition and social cognition at play as we see both cognitive variety and universality in the findings.

4.4. The Ball-Dot-Hole Study Findings

The results of this study show that: (1) perspective plays a role in choice; (2) when taking a perspective there is a *point* and a *view*; (3) the views are quite diverse (4.42%, 34.89%, 60.69%); (4) subjects' choice was influenced by a number of different distinctions and relationships they made (having to do with coded answer-groupings: other, superficial,

size, color, boundary). These findings show not only that the act of choice requires an act of Perspective taking, but also that Perspective taking, in turn, requires Distinction making (D), Relating (R), and part-whole grouping (Systems, or S).

The lowest number of subjects (4.4%) chose 'dot'. This is most likely because a dot is something people consider to be 'small' and 'filled in' ● rather than 'large' and 'open' ○. In other words, for most subjects, 'open' and/or 'not-filled in' and 'large' were parts of the conceptual whole that makes up hole or ball, but not dot. In the coding of groupings, we see this in the data in subjects' reasoned explanations such as:

> "[it's] too big for a dot and it wasn't filled. A hole is in something. This is mostly like a circle or ball."

Or,

> "A dot would be smaller and solid and black. A hole would be more elongated and filled in to represent a hole on the ground or something of that nature."

This indicates not only that distinctions (identities) are part-whole structures but also that, similar to the *Where's Waldo* study, in which a perspective is used as a filtering tool, this perspective itself is a part-whole System (S) made up of parts. In an important sense, this study is the mirrored reversal of the *Where's Waldo* study, cognitively speaking. In the Where's Waldo task, a perspectival filter was provided. The subject then distinguished the filter and deconstructed the concept into parts (green, red, plant, etc.). This concept was then used as perspective filter to search; for example, identifying something red but then realizing it is not also green and a plant, eventually led to identifying the red-green-plant. Whereas, in the *Ball-Dot-Hole* study, the view (not the point) was provided (○); the subject then deconstructed this view into parts (e.g, not filled in, open, big, not small, round, circular, not-slanted, not in something). These parts were then related (matched) to the parts of the available answers. The best match was chosen. This demonstrates the universality and mutual dependencies of D, S, R, and P. Table 22 provides a hypothetical example of the stepped DSRP logic.

Table 22. Cognitive Steps From Question to Answer Going Through DSRP.

Question: What is it? ○ **Answer Choices**: dot, ball, or hole
Cognitive step 1: *Distinguish various concepts (○, dot, ball, hole) by deconstructing into parts (attributes)*…
○ ∋ {large, circular, round, no fill,…}
ball ∋ {large, circular, round, sphere,…}
hole ∋ {large, circular, round, elongated, in something,…}
dot ∋ {circular, round, filled in, small, black,…}
Cognitive step 2: *Relate part-whole structures to identify closest match*…
○ ∋ {large, circular, round, no fill}
ball ∋ {large, circular, round, ~~sphere~~}
hole ∋ {large, circular, round, ~~elongated, in something~~}
dot ∋ {circular, round, ~~filled in, small, black~~}
Cognitive step 3: *Closest match = answer*…
○ ∩ ball = {large, circular, round}
Reasoned Answer: ball

Set notation used, where 'X contains parts' is noted as X ∋ {_, _, _} and ∩ denotes 'intersection of sets'.

These cognitive steps occur rapidly in the mind, often well beneath our conscious awareness, and not quite as linearly as is presented here in the example. However, what

this example illustrates is that the simple act of answering a question requires *distinguishing*, *part-whole deconstruction*, and *relating* the parts of these whole structures, all of which differs according to one's *perspective*.

4.5. The Where's Waldo Study Findings

No one (N = 1510), when asked to describe the fishtank, before OR after priming, described the red or green plant. Yet, when used as a perspective in search, 81.48% (M = 0.81, SD = 0.39, CI = 99%) identified it. This indicates that, *aided with a perspective filter*, search and identification of non-obvious items in a background of items is easier.

For the 85.50% (M = 0.86, SD = 0.35, CI = 99%) of people who correctly clicked on parts of the filter, the aggregate correctly identified all of the visible parts (See Figure 19 where the pink outlines (added) show the actual location of the visible parts of the filter in the image). These aggregated heatmaps indicate that the same cognitive processes used at the individual level of cognition are also present in social cognition.

The accuracy and completeness of these aggregated heatmaps for the 'Click the filter' task (Figure 19), also demonstrates that there is wisdom in the crowd as seen again in the 'Click on not-X' task (Figure 20). 57.24% (M = 0.57, SD = 0.50, CI = 98%) clicked correctly on a spot that was 'NOT a fish, gravel, rock, coral, vase or plant', thus demonstrating that concepts form individually and in the aggregate (i.e., social cognition) with relative accuracy utilizing DSRP (See Figure 20). This study, in multiple parts, elucidates the complexity involved in searching a scene for an identity (distinction). This disarmingly simple activity requires a perspective. This research shows that both the *point* and the *view* can be used to identify distinctions (either the identity or the other) which are themselves interrelated parts that make up systems. Thus, this research shows the fundamental dynamics and inter-dependencies between Distinctions (D), Systems (S), Relationships (R), and Perspectives (P).

Figure 19. Individual and Social Cognition Identifies All Visible Parts of Filter.
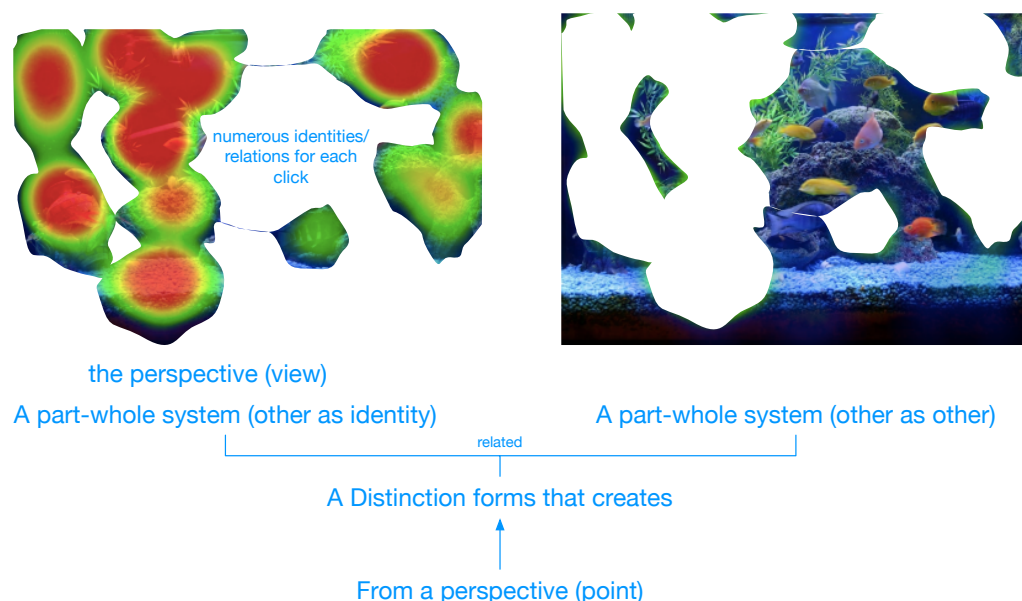
Figure 20. Individual and Social Cognition.

Figure 20 also demonstrates the role perspectives play (dependencies) in creating even complex Distinctions that involve systemic identities and others (that is, complexes of part-whole and relational structure).

92.13% (M = 0.92, SD = 0.27, CI = 99%) of people correctly clicked on eyeball when perspectively prompted. Eyeballs are visible in the image. However, 82.20% (M = 0.88, SD = 0.32, CI = 99%) of people correctly clicked on in the area a liver would be when perspectively prompted. Livers are NOT visible in the image. This means people had to imagine this part to find it (See Figure 21).
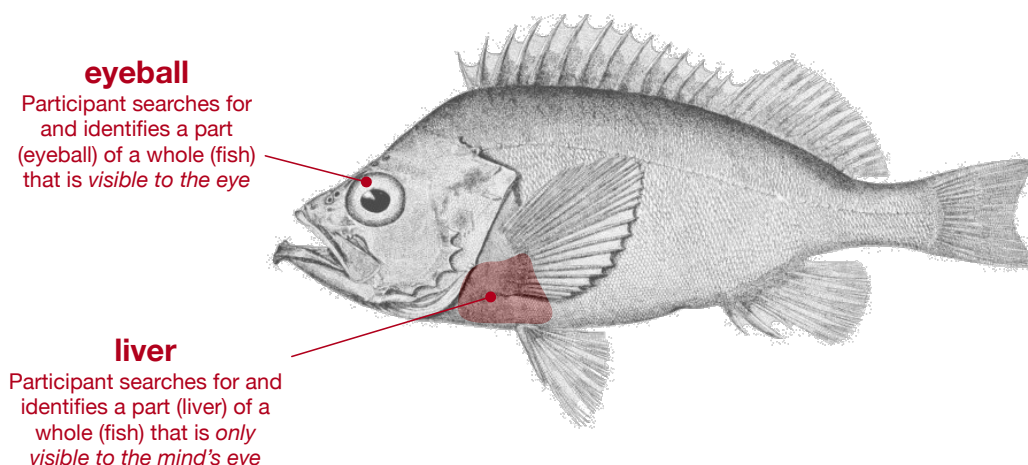
Figure 21. Image-ining Fish Livers.

A number of conclusions can be made as a result of this study:

- Perspectival filters are highly effective in searching and finding tasks;
- Both *point* and *view* are part-whole systems made up of related parts;
- Both point and view are Distinctions (an identity);
- Point-view Perspectives are effective in making structural predictions; even when structural prediction are used to "image-ine" things that exist but that are not obvious; and
- Point-view Perspectives are co-dependently related to part-whole Systems, identity-other Distinctions, and action-reaction Relationships.

4.6. The Financial Fish Study Findings

When coded for whether or not participants (N = 392) took a fish's perspective, 185/392 or 46.68% of participants took an obvious fish perspective. All other responses were ambiguous. For example, if the participant responded, "fish, gravel, vase" that was determined to be ambiguous and thus coded a '0' for each response. However, if the participant responded, "*home*, fish, gravel, vase" that was determined to be from a fish's perspective and received a code of '1' for each response. Of the 1328 total responses, 53.61% or 712/1368 were obviously from a fish's perspective. To be clear, the remaining 46.39% were not necessarily *not* from a fish's perspective, they were simply ambiguous and unable to be coded as such.

Coded for whether or not participants (N = 342) took a financial perspective, 206/342 or 60.23% of participants took an obvious financial perspective. All other responses were ambiguous. For example, if the participant responded, "fish, gravel, vase" that was coded as '0' to be ambiguous for each response. However, if the participant responded, "costs of fish, costs of gravel, costs of vase" that was determined to be from a financial perspective and coded as '1' for each response. Of the 762 total responses, 59.97% or 457/762 were obviously from a financial perspective. To be clear, the remaining 40.03% were not necessarily not from a financial perspective, they were simply ambiguous and thus not coded as such.

This research illustrates with *high statistical significance* how a single distinction (the identities: *fish* or *financial*) provides a perspective (point) that completely alters the DSRP configuration of the view. It shows that perspective (point-view) is a powerful (in terms of its effect) cognitive skill and tool. This research shows this at both the individual and collective cognitive levels.

In addition, generalized linear mixed modeling (mixed ordinal logistic regression) showed that subjects were 2.29 times more likely to take a conceptual (financial) perspective than an animate (fish) perspective. This unexpected finding counters nearly two decades of anecdotal experience that says that people generally have more difficulty with conceptual perspectives than animate ones (e.g., 'perspectives with eyes' like frog, fish, dog, etc.). It means that more research is needed in this regard. One possible explanation is that *familiarity* plays a role and therefore that *financial* was, while *conceptual*, also *familiar*. In other words, the many terms ending in the suffix *-al* (such as the 12 of the 14 systems engineering perspectives: financial, technological, historical, social, health and safety, political, emotional, moral/ethical, security, ecological, cultural, legal, organizational) are familiar to us as points-of-view in our collective perspective taking. the suffix *-al* performs two functions:

1. it transforms *nouns* into *adjectives*, "with the meanings *relating to*, *of the kind of*, or *having the form or character of*, such as *autumn + -al → autumnal* (= relating to the season autumn) or *nature + -al → natural* (= having the character of nature)".
2. it transforms *verbs* into *nouns*, "with the meanings, *the act of* such as *deny + -al → denial* (= the act of denying); or *refuse + -al → refusal* (= the act of refusing)" [129].

In the case of the first, transforming nouns into adjectives, it may be that this subtle grammatical trick is a linguistic form of "*perspective-izing*" in that it takes an inanimate and conceptual thing and makes it a adjectival form that is *relating to*, *of the kind of*, or *having the form or character of* such that we can see from its point of view. In other words, the suffix *-al* (and the cognitive trickery that belies these linguistics) transforms something conceptual into something animate. This alone however, is likely not enough, as it is the familiarity that matters as well. These are familiar terms (a *financial* perspective) different from say: a sausage-*al* perspective; a calculator-*al* perspective; or a rug-*al* perspective. Here we transform these conceptual nouns (without eyes) into adjectives but we lack the familiarity of the transformation. Nevertheless, the fact that subjects had greater ease with financial than fish perspective is unexpected and interesting and requires further research.

This future question aside, the *Financial Fish Study* shows—with high statistical significance—that point-view Perspective (P) is a *transformational* cognitive variable. It

has illustrates empirically how, "when you change the way you look at things, the things you look at change". This means that altering the point variable alters the identities and others and distinctions one makes, alters the part-whole groupings one constructs, and alters the action-reaction relationships one draws. It is no wonder then, that in our next studies, we see the transformative effect of Perspective taking as a metacognitive (known or aware) skill.

4.7. The P-Mapping Study Findings

The existence of point-view Perspectives is shown in the previous studies. The effectiveness of point-view Perspectives is shown in the *Fishtank*, *STMI*, and **P Mapping** studies. Point-view Perspectives are able to be utilized as a metacognitive skill with highly statistically significant effect and can be measured in terms of competence and confidence.

Table 18 shows that when faced with a blank canvas and the task of thinking through an issue, thought, problem, or system, nearly half of subjects (48%!) *'freeze up'*! This finding matches with anecdotal experience. People become overwhelmed by options when given free reign or asked open ended questions. The first thing that the other 52% of people did, was to create an *identity*—indicative of a Distinction. See Table 18 for more information on what subjects did and did not do. There is much that can be learned from the statistics about metacognition. Table 19 explicates what we can learn from the data while summarizing it. It gives the reader a *best practices* list of things to continue to do and things we can try to do more of. Doing more and becoming aware of the things on this list is, part and parcel of, systems thinking.

4.8. The P-STMI Study Findings

We see the theoretical universal of point-view Perspectives can also be utilized as a metacognitive skill that can be measured in both competence/skill and confidence in both the *Fishtank Study* and the *R STMI Study*[7]. We should keep in mind the Dunning–Kruger effect that appears in our sample. It demonstrates that we should be careful not to overestimate our competency in the point-view Perspectives skill.

Combined with the P-Mapping Study results, these data show us not only that point-view Perspectives (P) is the highest in terms of the Dunning-Kruger effect (more confidence than competence) but also that P-rule is something we do significantly less of than we need to. This is especially true given the results of the perspectival primes studies. P-rule is not only incredibly important, it is also overestimated, and under utilized.

4.9. The P-Fishtank Study Findings

The *P Fishtank Study* shows with high statistical significance that a less than 1 min intervention on the fundamental ideas of point-view Perspectives has a positive effect on cognitive complexity. People see quantitatively deeper and qualitatively more. Given the short exposure to treatment (on average, a 28.11 s read), these findings indicate a statistically significant increase in the degree to which people made more detailed perspectives. With a more substantive treatment (such as an online course) the effects may be transformative.

4.10. Limitations

There are several [potential] threats to validity to these studies. Most of these threats could be mitigated with the addition of control groups. As with all research of this type, some aspects could be improved by correlating results with other validated measures (if they exist) to ensure criterion validity. In addition, samples (where specified) were limited to adults in the US. therefore, results and conclusions could be stronger if the sample included minors and/or people from other countries to verify effects across age, language, and culture. Finally, instrument design that relied predominantly on other attributes (if they exist) (e.g., attributes other than visual imagery and language) could reduce threats to validity.

5. Summary of Findings on Existence, Universality, Efficacy, and Parallelism

With high statistical significance, these nine studies (along with the other studies mentioned in the literature review) provide an "ecology" of findings about point-view Perspectives (P-rule). Each study adds a brick to the wall of our understanding of point-view Perspectives and answers important questions about: (1) how and why point-view Perspectives form; (2) the internal and external dynamics of point-view Perspectives; (3) the role point-view Perspectives play in individual and social cognition; (4) the role point-view Perspectives play in metacognition; and (5) the effects of metacognitive awareness of point-view Perspectives on cognitive complexity.

In these nine studies, we see that the *point* and *view* elements of the *Perspectives* pattern are *co-implying*, *interchangeable*, and *inextricably linked*.

$$
\mathbb{D} : \exists AB
$$

$$
\exists A_{\rho} \xmapsto{\ implies\ } \exists B_{v}
$$

$$
\exists B_{v} \xmapsto{\ implies\ } \exists A_{\rho} \tag{5}
$$

$$
\exists A_{\rho} \xLeftrightarrow{\ co\text{-}implies\ } \exists B_{v}
$$

In Equation (5), we see that if any content information A which is a *point* (ρ), A_{ρ}, *exists* ($\exists$), then it *implies* ($\Rightarrow$) that a *view* (v) or B, must also exist, B_{v} (i.e., if a point exists, a view must exist). The same is true in the reverse where B_{v} implies ($\Rightarrow$) A_{ρ} (i.e., if a view exists, a point must exist). Thus, point and view, as structural patterns of cognition are *co-implying*.

Thus, in Equation (6), we see that the *point-view* elements of *Perspective* are *universal* to all forms of perspective taking and it s derivatives (i.e., empathy, compassion, theory of mind, awareness, metacognition, etc.). Additionally, these universal elements are *interchangeable* such that any *point* can also function as *view* and vice versa:

$$
P = \rho \xLeftrightarrow{\ co\text{-}implies\ } v
$$

$$
f : \rho \to v \tag{6}
$$

$$
f : v \to \rho
$$

The combination of the ecology of research explained thus far as well as the number of empirical studies in the literature across disciplines that directly (See Figure 1) establishes point-view Perspectives as a phenomenon in both mind and nature. This means that, whether you are aware of it or not, Perspective is at play. However, we also want to understand the effects of knowing about, being aware of, or being metacognitive where Perspective is concerned.

Here we turn to the efficacy of point-view Perspectives or P-rule. Will awareness of P-rule increase cognitive performance or complexity? The research in P-STMI, P-Mapping, and particularly P-Fishtank—with high statistical significance—shows convincingly that it is effective, even with 'low dose' interventions lasting less than one minute.

In other research studies based on the same research program and yielding highly statistically significant results, the identity and other variables of Distinctions (D) [119], the part and whole variables of Systems (S) [121], the action and reaction variables of Relationships (R) [120], and the point and view variables of Perspectives (P) (detailed herein), were *all* shown not only to be *mutually dependent* but also necessary and sufficient in their universality. Like the studies presented herein for point-view Perspectives (P), a collection of studies was undertaken to test the efficacy and existence of, respectively, the D, S and R rules. These studies show that Perspectives (P) are a factor in the formation of identity-other Distinctions (D), part-whole Systems (S), and action-reaction Relationships (R).

All with *high statistical significance*, the *Only See Blue* and *Where's the Plant?*, *What's a Bat?*, *Where's Waldo?*, *Financial Fish* studies, along with an transdiscplinary review of the

literature, illustrate the universal role that point-view Perspectives (P) play in our lives (in both mind and nature). The P-STMI, P-Mapping, and P-Fishtank studies illustrate the effectiveness that metacognitive awareness of P-rule can have. From the results of these four studies of point-view Perspectives structure detailed above, we can conclude several things. In summary, with high statistical significance, *Perspectives (P) are:*

1. Universal to the organization of Information:
   (a) in the *mind* (i.e., thinking, metacognition, encoding, knowledge formation, science, including both individual and social cognition, etc and
   (b) in *nature* (i.e., physical/material, observable systems, matter, scientific findings across the disciplines, etc.).
   (c) the basis for massively parallel and transforming co-priming effects in networks in both mind and nature (e.g., changing a perspective (point or view) changes the identity-other Distinctions, action-reaction Relationships, and part-whole Systems).
2. Made up of elements (point, view) that are:
   (a) *co-implying* (i.e., if one exists, the other exists; called the co-implication rule);
   (b) related by a special[8] relationship: observes/observed; and
   (c) act simultaneously as, and are therefore interchangeable with, the elements of Distinctions (identity, other), Systems (part, whole) and Relationships (action, reaction). This is called the simultaneity rule.
3. Mutually-dependent on identity-other Distinctions (D), part-whole Systems (S), point-view Perspectives (P) (such that D, S, R, and P are both necessary and sufficient).
4. Taken metacognitively:
   (a) constitute the basis for making *structural predictions* about information (based on co-implication and simultaneity rules) of observable phenomena and are therefore a source of creativity, discovery, innovation, invention, and knowledge discovery; and
   (b) *effective* in navigating cognitive complexity to align with material systems complexity.

Keeping the findings in mind, let us return to the table of research questions (3). In conclusion, these data suggest the empirical and observable *existence*, *efficacy*, *parallelism* (between cognitive and ontological complexity), and *universality* of point-view Perspectives (P), and with high statistical significance, point to the conclusions and summaries in Table 23.

Table 23. Summary Table of Conclusions.

Conclusions	Summary
Globally and universally, point-view perspectives exist. Every perspective has a *point* and *view* variable.	P_v^ρ exists and is universal.
When we change the perspective, we change the distinctions, systems and relationships that we see. Perspective can cause people to see things that are not visible. Perspectives are not static. They can change when the context in which they occur changes; and they can change the context.	Perspective is *transformative*.
P-rule is dependent on D, S and R rules, and D, S and R rules are dependent on P-rule.	DSRP is massively parallel and fractal.
When a perspective aligns with our own it is easier to take. When a perspective does not aligns with our own it more difficult to see.	Metacognition of P matters.
Perspective plays a role in choice. The act of choice *requires* an act of Perspective taking. Provided a perspective, people are able to choose, find, discover the answer faster. Without a perspectival filter, they have more difficulty.	Awareness of P-rule aids decisions/choices.

Table 23. *Cont.*

Conclusions	Summary
Explicit use of perspectives can be used to *constrain* or *expand* thought.	P-rule *governs* convergent or divergent thinking.
We know what people do and don't do with Perspectives that can help us improve thinking. Namely: Rarely make perspectives explicit; rarely take multiple perspectives; rarely take conceptual perspectives.	Awareness of P-rule improves thinking.
People have greater confidence than competence in perspective taking.	We are overconfident with P_v^ρ
People take both conceptual and physical perspectives but have more difficulty with conceptual ones. This difficulty limits their cognitive flexibility.	Increasing conceptual perspective taking increases cognitive flexibility.
Perspectives are made at the individual and collective level. At the collective level, the "wisdom of the crowd" emerges such that many perspectives are covered. We could improve individual cognition if we mimic the perspective-taking of this collective action.	P-rule is a powerful cognitive tool.
A relatively short treatment in P-rule can dramatically affect cognitive ability and complexity.	"P-rule" makes you smarter.

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Abbreviations

The following abbreviations are used in this manuscript:

DSRP	DSRP Theory (Distinctions, Systems, Relationships, Perspectives)
D	identity-other Distinctions
S	part-whole Systems
R	action-reaction Relationships
P	point-view Perspectives
STMI	Systems Thinking and Metacognition Inventory
IQR	Interquartile range
GLMM	Generalized linear mixed modelling
RDS	Relate-Distinguish-Systematize Jig

Notes

1.   Cabrera [122] writes, It should be notes that "the ST/DSRP Loop is the mirror opposite of confirmation bias. Confirmation bias reverses this loop, by *fitting* reality to one's mental models, whereas DSRP-Systems Thinking *fits* mental models to real-world observables and feedback. *Parallelism* is therefore the degree to which one's cognitive paradigm, style, or mindset, aligns with nature's. One purpose of this research program, is to determine the degree to which DSRP Theory accomplishes this parallelism".

2.   STMI is the acronym for the Systems Thinking and Metacognition Inventory.

3.   Analysis was performed using Chi-square test for goodness of fit. X^2: Chi-square statistic.

⁴ Results showed that no statistically significant association was observed (p > 0.05 for all comparisons) between any of the sociodemographic factors and answer choice, other than place of residence (Urban, Suburban, Rural; P = 0.04). Analysis was performed using Chi-square test of independence. Respondents who reported seven were more likely to be from urban areas (56%) than respondents who reported four (32.1%). None of the remaining sociodemographic characteristics were significantly associated with the reported result.

⁵ as coded-correct.

⁶ Full disclosure, Plectica Systems Mapping Software was invented by Dr. Derek Cabrera and used for years as a pilot software for research purposes (it was originally called MetaMap). Cabrera later co-founded Plectica and developed the software further as a consumer application. Plectica was then sold to Frameable and Cabrera is no longer actively involved in the company.

⁷ Both the Fishtank [122] and the STMI Study focused on more than just the existence of point-view Perspectives. See [118].

⁸ "Special" here refers to the specific relationship. In contrast to general or universal relationships.

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