Self-Consistency for LLM-Based Motion Trajectory Generation and Verification

Supplementary Material

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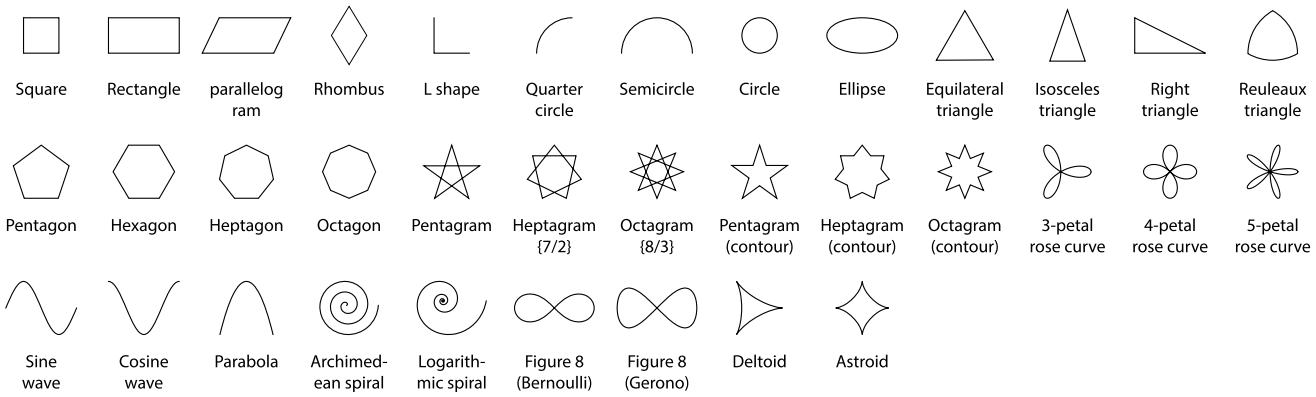


Figure S1. Our benchmark includes 224 prompts of motion trajectories derived from 35 different geometric base shapes. Variations are created by adding specifications to each shape to exercise different warps in our hierarchy of transformations.

Contents

A. Motion Trajectory Benchmark Details

Our benchmark consists of 224 motion trajectory prompts describing 35 different basic shapes, as shown in Figure S1. Each prompt is paired with a ground truth shape family following the definition of Equation 1 in the main paper – one prototype trajectory and a transformation group. Table S1 reports the number of prompts associated with each transformation group. The distribution is determined by the geometric properties of the base shapes (e.g., a circle cannot have anisotropic similarity or affine warps). We discuss and show examples of applying our approach to shape families that do not follow this definition in Section C.1. We illustrate all 224 prompts with their ground truth shape families in our benchmark in Figure S8–S14.

We use a template-based approach to generate the prompts, following MoVer [8] and CLEVR [6]. Each prompt starts with the main sentence `Animate the <SVG element> to move along a path shaped like <shape name>.` We manually pair a prompt to its ground truth shape family consisting of a Lie group of transformations and a prototype trajectory based on the shape properties. For example, we pair "circle" with a circular trajectory and the warp $W_{\text{sim-ref}}$ (similarity with reflections), "ellipse" with an elliptical path and $W_{\text{sim-ani}}$ (anisotropic similarity), and "parallelogram" to a parallelogram path with W_{aff} (affine). We note that, for shapes that are periodic (sine and cosine waves) or

Table S1. Number of prompts per warp in our benchmark.

$W_{\text{rgd-ref}}$	W_{rgd}	W_{sim}	$W_{\text{sim-ref}}$	$W_{\text{sim-ani}}$	W_{aff}	Total
105	44	38	23	12	2	224

self-repeating (Archimedean and logarithmic spirals), the prompts need to specify the number of periods or turns, as changes in these values effectively create different shape families (e.g., a spiral with 2 turns cannot be geometrically warped into a spiral with 3 turns). We add a new sentence after the main sentence for this value: `Complete <periods/turns> of <shape name>.`

To introduce prompt variations that exercise all geometric warps in our hierarchy, we add modifiers to a prompt in the form of additional specifications on a shape. The first type of specifications is *shape orientation*, where we require a shape to be traversed in either a clockwise or counterclockwise manner. Adding this specification removes reflections from the warps. We use the following template sentence: `Traverse the path in a <orientation> manner.`

The second type of specifications is *shape size*. For some shapes, their sizes can be fully specified by one parameter (e.g., radius for circles and side length for polygons). Others require two parameters, such as width and height for rectangles and triangles, and horizontal extent and amplitude for sine and cosine waves. Fully specifying a shape's size reduces the transformation group to either W_{rgd} (rigid) or $W_{\text{rgd-ref}}$ (rigid with reflections). Alternatively, we can specify a shape's size in terms of ratios (e.g., a rectangle with a 4:3 aspect ratio), and doing so changes the transformation group to either W_{sim} or $W_{\text{sim-ref}}$. We append a prepositional phrase to the main sentence when adding size specifications: `a <shape name> with <size param name> of <size param value>` (e.g., *"a rectangle with a width of 50 px and a height of 80 px."*).

B. Decision Criteria Alternatives

In Section 4 of the main paper we describe how our method is able to recover a shape family from an input prompt. A critical component of this procedure is how to estimate which transformation group W, from our hierarchy of Lie transformation groups (Figure 3, main paper), is most appropriate. We introduce two decision criteria for selecting W, based on underlying assumptions made in the sampled motion trajectory distributions produced by an LLM: Majority-Consensus (Section 4.3.1) and Hierarchical-Consistency (Section 4.3.2). How do we know whether the decision criteria we propose select useful transformation groups? One way to justify our design of these procedures is by comparing their performance against very simple decision criteria alternatives. To this end, we consider two additional 'baseline' decision criteria, which we expect will recover worse shape families compared with Majority-Consensus and Hierarchical-Consistency. *Most-Restrictive* is a criterion that always selects the most restrictive transformation group in our hierarchy (rigid). *Least-Restrictive* is a criterion that always selects the least restrictive transformation group in our hierarchy (affine).

Motion trajectory generation With the same experimental set-up as described in Section 5.2 of the main paper, we compare how the different decision criteria aid in the task of motion trajectory synthesis. We report results of this experiment in Table S2. As a reminder, the metric we track is the "accuracy" of the generations, i.e., whether the production is a member of the ground-truth shape family from our benchmark dataset. For better numerical stability, we compute this accuracy as the ratio of true to false trajectories in the chosen cluster, averaged across tasks in the dataset. Note that for LLM-Direct, we say that the "chosen cluster" includes all trajectories produced from the same prompt.

We find that the two baseline decision criteria do strictly worse compared with the more sophisticated alternatives. Even these simple ways of choosing W do provide some benefit within the self-consistency paradigm in terms of improving the accuracy of the LLM's generations. For instance, Most-Restrictive is able to increase the accuracy over LLM-Direct by between 3 and 4 absolute percentage points. These results show that even with sub-optimal choices of W, self-consistency can benefit from the greater flexibility afforded in terms of checking whether generations match beyond identity comparisons.

Motion trajectory verification Following the experimental set-up as described in Section 5.3 of the main paper, we compare how these alternative decision criteria perform on the task of motion trajectory verification. We report results of this experiment in Table S3. Hierarchical-Consistency continues to achieve the best F1 score, finding a nice balance between precision and recall. One way to view Least-Restrictive is as a partial implementation of Hierarchical-Consistency; this simplification to never descend the hierarchy results in a steep decrease in precision (15 points) with only moderate increases to recall (3 points). In a similar fashion, Most-Restrictive can also be considered a partial implementation of Majority-Consensus. Always choosing the most restrictive transformation group provides a marginal benefit for precision (.3 points), but it dramatically drops the associated recall (24 points).

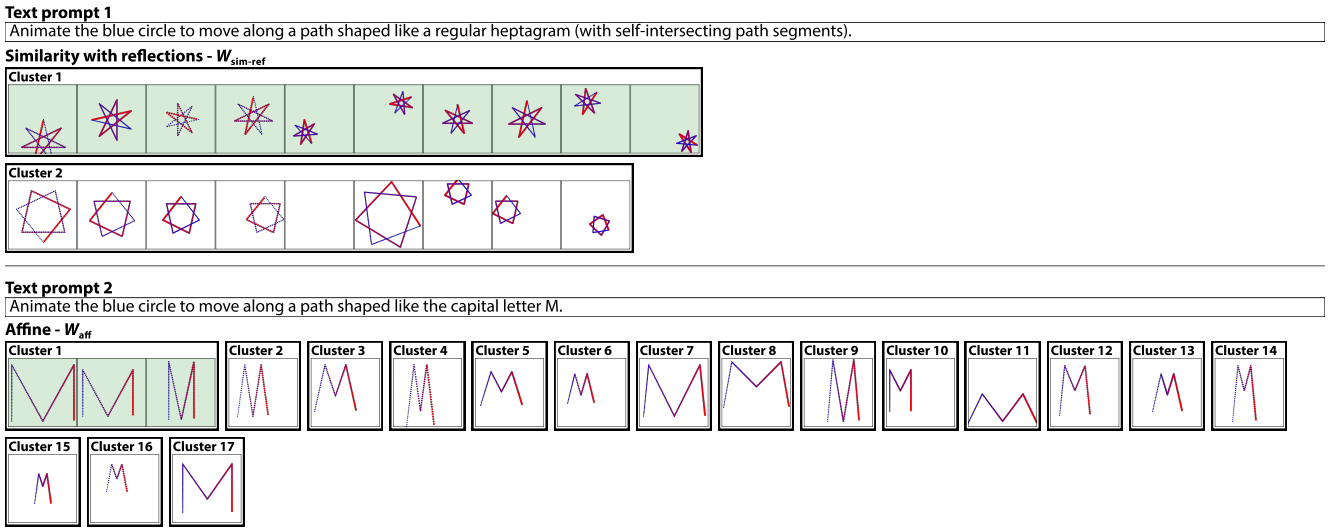


Figure S2. We demonstrate a limitation of our self-consistency approach in terms of the definition of a shape family. In text prompt 1, "heptagram" has two distinct prototypes: heptagram {7/2} and heptagram {7/3}. Under the warp $W_{\text{sim-ref}}$, cluster 1 contains correct {7/3} trajectories, while cluster 2 has {7/2}. While, for generation, our approach would produce a correct interpretation of heptagram, we would mark all heptagram {7/2} as false for verification. Similarly, for the letter Ms in text prompt 2, our approach would generate a correct form of the letter, but verify all other letter Ms that are not an affine warp of the shapes in cluster 1 as false.

Table S2. Motion trajectory generation experiment with two additional baseline decision criteria of always selecting the most or least restrictive warps. We observe that they perform strictly worse than the two methods proposed in the main paper.

Method	Decision Criteria	GPT-4.1	GPT-5
LLM-Direct	—	62.1	79.1
Ours	Majority-Consensus	**68.0**	**83.3**
Ours	Most-Restrictive	66.5	82.5
Ours	Hierarchical-Consistency	66.7	82.6
Ours	Least-Restrictive	64.6	82.1
Ours	Oracle	68.5	83.5

Table S3. Motion trajectory verification experiment (Table 2 of the main paper) with additional decision criteria of always selecting the most or least restrictive warps.

Method	Decision Criteria	Precision	Recall	F1 Score
GPT-4.1	—	62.0	96.9	75.6
GPT-5	—	74.0	84.7	79.0
Ours	Majority-Consensus	85.8	66.1	74.6
Ours	Most-Restrictive	86.1	42.1	56.5
Ours	Hierarchical-Consistency	80.5	89.0	84.6
Ours	Least-Restrictive	65.0	91.8	76.1
Ours	Oracle	87.9	83.3	85.6

C. Shape Family Limitations

C.1. Shape Families Requiring Multiple Prototypes

In our work, we define a shape family $\mathcal{F}(o, W)$ in Equation 1 of the main paper with one prototype and one geometric warp, and have demonstrated that a wide variety of common shape families (Figure S1) that people use to describe motion trajectories falls under this definition [11].

However, there are shape families that cannot be represented this way. One type of such families requires multiple but finitely many prototypes under one particular warp. For example, as described in the main paper, the shape family "heptagram" needs two distinct prototypes: heptagram 7/2 and heptagram 7/3 under the similarity warp (Figure S2). Another type of families either needs an infinite amount of prototypes under one warp, or one prototype with some sophisticated, non-geometric warp. An example of this is the family of any letter of the English alphabet, like the capital letter M (Figure S2). As demonstrated by Hofstadter and McGraw [5], since there are countless ways to produce a trajectory that a human would perceive as an 'M-shape', we either need an infinite number of prototypes or a warp beyond the geometric transformations we consider.

In Figure S2, we prompted for the heptagram and capital M shapes. In both cases, while the largest clusters do contain correct trajectories for generation, applying them for verification would result in limited recall, as correct shapes

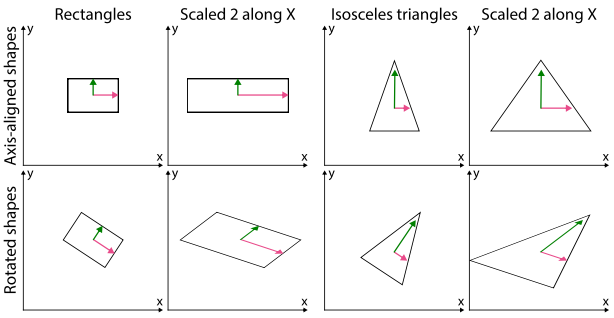


Figure S3. When a shape is aligned with the screen space's coordinate frame, applying an anisotropic scale of 2 along the x-axis does not introduce skews to the shapes (top). However, once a shape is rotated out of alignment, non-uniform scales effectively skew the shapes out of their respective shape families (bottom).

that cannot be mapped to by the single prototype and the warp would be labeled as false.

C.1.1. Extension to Multi-Prototype Shape Families

For shape families requiring a finite number of prototypes under one warp, we experimented with a simple modification to Hierarchical-Consistency that returns all largest clusters whose sizes are within 20% of one another, instead of only the single largest cluster. We tested this modification on four multi-prototype prompts under $W_{\text{sim-ref}}$: heptagram (2 prototypes: {7/2}, {7/3}; Figure S2), heptagram outline (2 prototypes: {7/2}, {7/3}), octagram outline (2 prototypes: {8/2}, {8/3}), and hendecagram (4 prototypes: {11/2}, {11/3}, {11/4}, {11/5}). With regular Hierarchical-Consistency, the verification F1 score on these multi-prototype prompts is 71.0. After applying the 20% tolerance modification, F1 improves to 88.9. Meanwhile, the modification has a negligible effect on single-prototype prompts, with F1 decreasing only slightly from 84.6 to 84.5, as the tolerance occasionally causes an additional outlier cluster to be selected. This small experiment suggests that we can potentially extend our approach to handle multi-prototype shape families by returning the largest clusters that satisfy certain statistical relationships with one another. Future work should more comprehensively evaluate this on a larger set of multi-prototype prompts and explore other decision criteria for selecting multiple clusters.

C.2. Shape Families with Anisotropic Similarity

For shape families with the anisotropic similarity warp, when a shape is not aligned with the screen coordinate frame (bottom row of Figure S3), a skew can be introduced to distort it out of its family if a non-uniform scaling is applied to it [12]. For symmetric shapes like the ones shown in Figure S3, their lines of symmetry need to align with the screen coordinate axes. For asymmetric shapes with right angles (e.g., right triangles), the lines along the right angles need to be in alignment so that they are preserved under scaling. This means that, in order to properly warp to all other members of the family, we need a prototype that is in alignment with the screen space's coordinate frame for non-uniform scaling to be applied without skew. We manually ensure this when we are constructing ground truth shape families for our dataset, and assume that the LLM will generate some trajectories in such canonical orientations.

Table S4. Our decision criteria has different failure modes when not selecting the ground truth warp. Majority-Consensus selects more restrictive distance metrics for 108 prompts (95.6% of the time when it is not matching with the ground truth), while Hierarchical-Consistency is more conservative for 50 prompts (80.6% of the time). Note that both decision criteria choose distance metrics that are on the same level of the hierarchy but different from the ground truth for 1 and 3 prompts respectively.

Decision Criteria	More Restrictive	Match	Less Restrictive
Majority-Consensus	48.2%	49.6%	1.8%
Hierarchical-Consistency	4.0%	72.3%	22.3%

D. Failure Modes

D.1. Decision Criteria Failure Modes

Our method can recover a shape family from an input prompt by using some decision criteria to estimate an appropriate transformation group W. In Section 4.3 of the main paper, we introduce two such decision criteria that analyze the distribution of motion trajectories generated by an LLM. When different sets of assumptions are met, in terms of how the LLM generates motion trajectories, these decision criteria will predict the correct transformation group. For Majority-Consensus the assumptions it makes are (i) the LLM produces correct trajectories more frequently than incorrect ones; (ii) the collection of sampled trajectories diversely covers the modes of variation possible within the transformation group. Hierarchical-Consistency relaxes this second assumption, but introduces a new assumption in that incorrect trajectories produced by the LLM will not cluster with the correct trajectories produced by the LLM under any transformation group in our hierarchy. In cases where these assumptions are broken, it is possible for these decision criteria to fail (i.e. recover a different transformation group compared with the ground-truth annotation).

To demonstrate such cases, we include qualitative examples in Figure S4 and Figure S5. In each figure, we show LLM sampled motion trajectories from a text prompt (top of figure), and how these motion trajectories are clustered under different transformation groups from our hierarchy. The top transformation group we show is affine, the least restrictive, and transformation groups get progressively more restrictive, ending with rigid. For each transformation group,

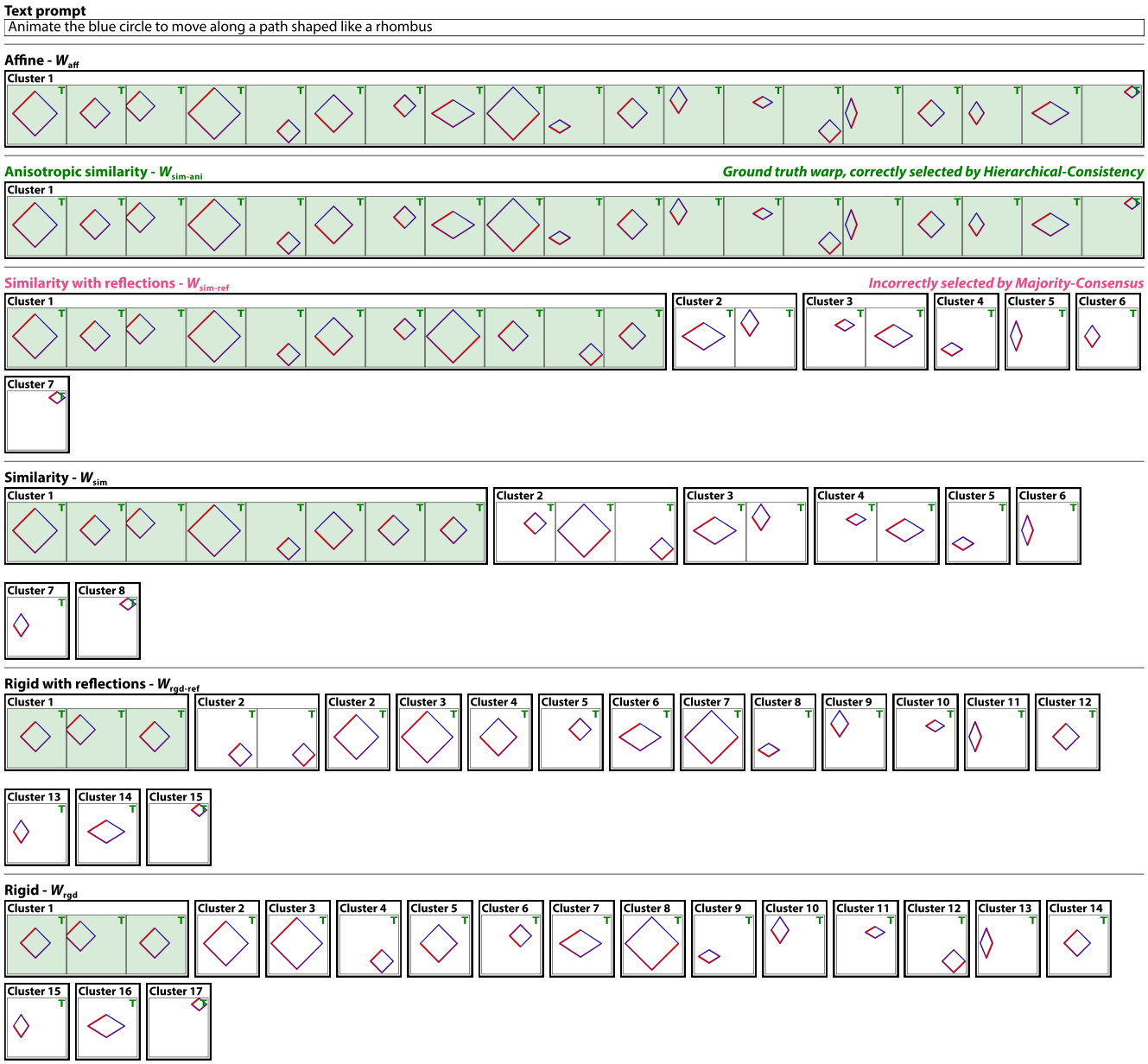


Figure S4. We demonstrate a case where Hierarchical-Consistency chooses the correct warp but Majority-Consensus fails by selecting a more restrictive warp. The prompt (top) asks for a rhombus-shaped path. We show clustering results of all warps in our hierarchy, with largest clusters under each warp highlighted in green. Each trajectory has a ground truth correctness label on the upper right.

we highlight the largest cluster in green. Each trajectory is labeled with a T/F value in the top-right corner, indicating whether it is a member of our ground-truth shape family.

In Figure S4, we demonstrate a case where Hierarchical-Consistency identifies the correct W, while Majority-Consensus fails. For this prompt, all of the LLM generated motion trajectories were correct. For Hierarchical-Consistency, for the affine transformation group it identifies the largest cluster, and observes that this cluster does not lose any members when the transformation group is made more restrictive with anisotropic similarity, which is the correct transformation group for this shape family. Trying to make W more restrictive (similarity with reflections) would break this cluster, so Hierarchical-Consistency succeeds by stopping at the previous step. In contrast, Majority-Consensus identifies that under the clustering produced by similarity with reflections, over half of the generations would be included in the largest cluster, so it incorrectly would choose an overly restrictive transformation group. This sampling

Figure S5. An example case where Majority-Consensus correctly chooses the ground truth warp but Hierarchical-Consistency fails by selecting a less restrictive warp. The prompt (top) asks for a path shaped like an equilateral triangle traversed in a counterclockwise manner. We show clustering results of all warps in our hierarchy.

breaks an assumption made by Majority-Consensus, as the LLM produced trajectories do not provide a balanced enough coverage over the modes of variation under the ground-truth transformation group (anisotropic similarity).

In Figure S5, we demonstrate a case where Majority-Consensus identifies the correct W, while Hierarchical-Consistency fails. In this case, 10 LLM generations were correct and 9 LLM generations were incorrect, as they produced paths that did not traverse in a clockwise manner (note time is indicated as a progression from blue to red in the renders). The correct transformation group in this case is similarity, as more permissive transformation groups would cause matches that violate the traversal orientation specification. Majority-Consensus starts with the clustering produced by the most restrictive transformation group (rigid), which has a largest cluster of size 3, and progressively considers less restrictive transformation groups until it finds a cluster with at least 10 members, correctly identifying similarity should be used as W. In contrast, Hierarchical-Consistency starts with affine, and once again identifies that all of the LLM productions are grouped into a single cluster. This cluster only loses

members on the transition from anisotropic similarity to similarity with reflections, so Hierarchical-Consistency will incorrectly choose an overly permissive transformation group. In this case, some of the incorrect LLM samples would cluster with correct samples under the affine transformation group, breaking an assumption made by Hierarchical-Consistency.

So, depending on the distribution of the LLM produced motion trajectories, these decision criteria can fail in their task of recovering the correct transformation group. We quantitatively analyze the prevalence of these failure modes in Table S4. For our two proposed criteria, Hierarchical-Consistency and Majority-Consensus, we record for all 224 prompts how the chosen transformation group compares with the ground-truth transformation group in the benchmark dataset. *Match* indicates the criteria chose the correct transformation group, while *more restrictive* indicates the criteria chose a transformation group too low in the hierarchy, and *less restrictive* indicates the criteria chose a transformation group too high in the hierarchy.

In general, we find that Hierarchical-Consistency more reliably identifies the correct W compared with Majority-Consensus (72% vs 49%). This likely indicates that the assumptions made by Hierarchical-Consistency are more often met compared with the assumptions made by Majority-Consensus. From the qualitative examples, we can see the LLM struggles to produce sufficiently diverse samples that cover all of the possible modes of variation, so this is likely a major source of error for Majority-Consensus. Beyond checking whether or not these decision criteria recover the exact ground-truth W, we can additionally analyze how these methods tend to fail. Majority-Consensus starts at the bottom of the hierarchy, stopping when a majority clustering is found. As such, Majority-Consensus is overly prone to producing more restrictive transformation groups when it makes mistakes (25 times more likely to have a more restrictive error compared with a less restrictive error). Hierarchical-Consistency starts at the top of the hierarchy, with a stopping criterion when the majority cluster begins to break apart. As such, Hierarchical-Consistency is overly prone to producing transformation groups that are too loose when it makes mistakes (5 times more likely to have a less restrictive error compared with a more restrictive error). These quantitative trends match the qualitative examples.

D.2. LLM Failure Modes

The general self-consistency approach makes an assumption that the LLM is likely to produce the correct response more often than any other incorrect response [14]. We examine cases where this assumption does not hold and present quantitative results in Figure S6. Applying our self-consistency approach with the oracle warps to the trajectories generated by GPT-5 from the 224 prompts in our dataset (same experimental set-up as Section 5.2 of the main paper), we see 16.1% of the prompts with largest clusters that do not contain any correct trajectories. For GPT-4.1 generated trajectories, we have 31.3% (70) such clusters.

We show examples of these failure cases in the bottom half of Figure S6. Text prompt 3 asks for a trajectory in the shape of an outline of a pentagram, and the oracle similarity warp puts the generated trajectories into three clusters. While the LLM (GPT-5) was able to produce the correct trajectory 5 times (Cluster 2), it generates more instances of a regular pentagram shape with the internal path crossovers in both clockwise and counterclockwise fashion. Text prompt 4 asks for counterclockwise reuleaux triangle-shaped trajectories. Under the ground truth rigid transformation warp, the generated trajectories are grouped into three clusters. The LLM (GPT-4.1) similarly generates the correct trajectory 5 times (Cluster 3), but falsely traces the construction lines of a reuleaux triangle for the other 14 times. In both of these cases, the incorrect trajectories formed largest clusters in the form of relative majority with 9 trajectories. As the LLM produces more trajectories outside of the ground truth shape families than inside, the general assumption of self-consistency does not hold and the largest clusters do not contain any correct trajectories.

E. Method Implementation Details

E.1. Computing Warp-Invariant Distance

Algorithm 1 presents our ICP-based approach [1, 2, 4] for computing the warp-invariant distance between a source trajectory R and target trajectory T under a geometric warp W. We begin by resampling both trajectories to have n equally-spaced points along their arc length. This resampling establishes initial point correspondences, where we assume that points at the same index in R and T correspond to one another. The outer loop then randomly selects 3 non-repeated, non-collinear point indices $\mathcal{I}$ from these trajectories. These three points provide sufficient constraints to estimate most geometric transformations in our hierarchy.

Given the sampled point indices, the inner loop iteratively refines the transformation A. At each iteration, we: (1) estimate a transformation A that aligns the sampled points from R_{trans} to the corresponding points in T, (2) apply this transformation to the source trajectory R, (3) resample the transformed trajectory for a new set of corresponding points, and (4) compute the average point-to-point distance. If the change in distance falls below a convergence threshold ϵ, the inner loop terminates. Otherwise, we map the newly sampled points back to the original R space by undoing the transformation and repeat. This iterative process effectively "nudges" points along trajectory R to better align with T under the transformation A.

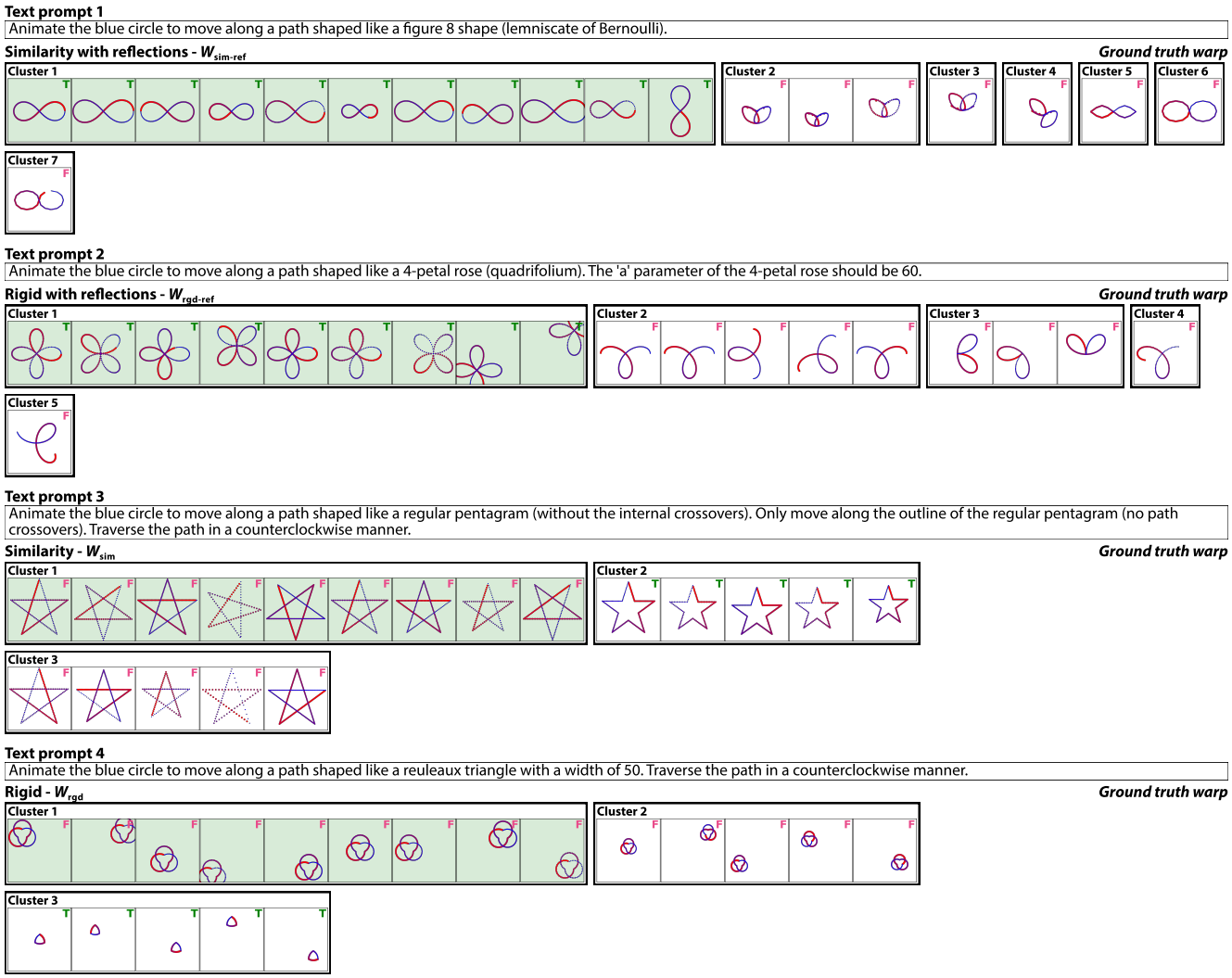


Figure S6. More results of applying our self-consistency approach with the oracle warps. The top half shows two success cases where the largest clusters do correspond to the correct shape families (figure 8 and 4-petal rose). The bottom half shows two failure cases where the LLM did not produce more members of the ground truth shape families than non-members (pentagram outline and reuleaux triangle).

After convergence, we check if the current alignment achieves a lower distance than previous iterations and update the best transformation $A_{\min}$ accordingly. The algorithm terminates when the distance falls below a threshold τ or after a maximum number of outer iterations. Our ICP-based implementation is a proof of concept to show the viability of our self-consistency approach for motion trajectories. It would likely be possible to improve its runtime with efficient variants in the future [9, 10].

Transformation estimation. `EstimateTransform` in line 11 of Algorithm 1 computes A based on the geometric warp type $\mathcal{W}$. For rigid and similarity transformations (with or without reflections), we use the Kabsch-Umeyama algorithm [7, 13], which computes optimal rotation, translation, and optionally uniform scaling and reflection via SVD. For affine warps, we directly solve the linear system relating source to target points. For anisotropic similarity, we test both $A = M_{\text{trs}} \cdot M_{\text{rot}} \cdot M_{\text{scl}}$ and $A = M_{\text{trs}} \cdot M_{\text{scl}} \cdot M_{\text{rot}}$ decomposition orders and select the transformation yielding the smaller distance.

Handling closed trajectories Our assumption that points with the same indices after arc-length resampling correspond to one another holds for open trajectories with distinct starting and end points. However, closed trajectories (e.g., circles, squares) may have arbitrary starting points. This means that, if T and R are the same closed trajectories but with distinct starting points, our algorithm will not be able to find an A that produces zero distance between them. To address this, we extend our algorithm with a coarse-to-fine search over different starting points along R. We com-

Algorithm 1 ICP-based Trajectory Distance Metric

Input: Source trajectory R, target trajectory T, and geometric warp type $\mathcal{W}$
Output: Minimum distance $d_{\min}$ between R and T with corresponding transformation matrix $A_{\min}$

$T \leftarrow \text{ResampleByArcLength}(T, n)$
$d_{\min} \leftarrow \infty$, $A_{\min} \leftarrow \mathbf{I}$
for $i = 1$ to M_{outer} **do**
  $R_{\text{trans}} \leftarrow \text{ResampleByArcLength}(R, n)$
  $d_{\text{prev}} \leftarrow \infty$
  $\mathcal{I} \leftarrow$ Randomly sample 3 point indices
  for $j = 1$ to M_{inner} **do**
    $A \leftarrow \text{EstimateTransform}(R_{\text{trans}}[\mathcal{I}], T[\mathcal{I}], \mathcal{W})$
    $R_{\text{trans}} \leftarrow A \cdot R$ ▷ Apply transformation
    $R_{\text{trans}} \leftarrow \text{ResampleByArcLength}(R_{\text{trans}}, n)$
    $d_{\text{avg}} \leftarrow \frac{1}{n} \sum_{k=1}^{n} \|R_{\text{trans}}[k] - T[k]\|_2$
    if $|d_{\text{avg}} - d_{\text{prev}}| < \epsilon$ **then**
      break ▷ Inner loop converged
    end if
    $d_{\text{prev}} \leftarrow d_{\text{avg}}$
    $R_{\text{trans}} \leftarrow A^{-1} \cdot R_{\text{trans}}$ ▷ Undo transformation
  end for
  if $d_{\text{avg}} < d_{\min}$ **then**
    $A_{\min} \leftarrow A$, $d_{\min} \leftarrow d_{\text{avg}}$ ▷ Update alignment
  end if
  if $d_{\text{avg}} < \tau$ **then**
    break ▷ Outer loop converged
  end if
end for
return $d_{\min}$, $A_{\min}$

Table S5. F1 scores of verification by Hierarchical-Consistency and the average number of DBSCAN clusters across the distance threshold τ.

	$\tau = 0.25$	$\tau = 0.5$	$\tau = 1.0$	$\tau = 2.0$	$\tau = 4.0$	$\tau = 8.0$
F1 score	84.0	84.6	83.8	83.1	80.3	76.8
Clusters (avg±std)	4.0±4.9	3.7±4.8	3.5±4.5	3.1±4.0	2.6±3.1	2.1±2.1

pute the distance metric with each point in R taken as the starting point and report the minimum distance across all starting points.

E.2. Sensitivity to DBSCAN Distance Threshold

Equation 2 of the main paper defines that two trajectories in the same shape family should have a distance of 0. We perform DBSCAN clustering with a small threshold τ (Section 4.2 of the main paper) only to account for discretization errors during resampling in our distance metric computation. Our approach is not sensitive to the value of τ. As shown in Table S5, increasing τ by a factor of 32 (from 0.25 to 8.0) results in only a 7.2 percentage point drop in F1 score.

E.3. Generating Motion Trajectories with an LLM

To use an LLM for motion trajectory animation generation, we follow the approach proposed by MoVer [8]; we prompt an LLM with a system message containing overall instructions and the complete documentation of an animation API (GSAP [3]), followed by a user prompt that contains the static SVG code to be animated, the description of a motion trajectory, and additional instructions.

We modify the MoVer approach in two places. First, we updated the animation API with an additional function `setProperty()` that allows changing an element's properties like positions without adding animation tweens.

```
/**
 * This function immediately sets properties on an SVG element without animation. Use this function to initialize or instantly update element properties such as position, scale, rotation, opacity, etc. This is useful for setting up initial states before animating.
 * @param {object} element - The SVG element whose properties should be set.
 * @param {object} properties - An object containing property-value pairs to set on the element. Common properties include x, y, scaleX, scaleY, rotation, opacity, transformOrigin, and svgOrigin.
 * @returns {void} - This function does not return anything.
 * @example
 * // Set the translate transform value of the element to [100, 200].
 * // Here, x, y values set the translation of the element (displacement from its original position at the start of the animation).
 * setProperty(circle, { x: 100, y: 200 });
 */
function setProperty(element, properties)
```

For the user prompt, we append additional instructions shown below after the motion trajectory prompt. At the end, we instruct the LLM to produce five diverse animations following the diversity prompting strategy [15].

```
SVG Code:
{{ svg code }}

Prompt:
{{ motion trajectory prompt }}

## Additional Instructions
- Note that the negative y-axis is the upward direction in the SVG scene.
- To start a path animation, use setProperty() to position the element at the beginning of the path. Be mindful of the SVG viewbox and not move the element and the path out of view.
- For curved paths, use multiple consecutive very short linear translations to achieve smooth motions.
- The entire animation should last between 1 and 5 seconds unless otherwise specified.

```

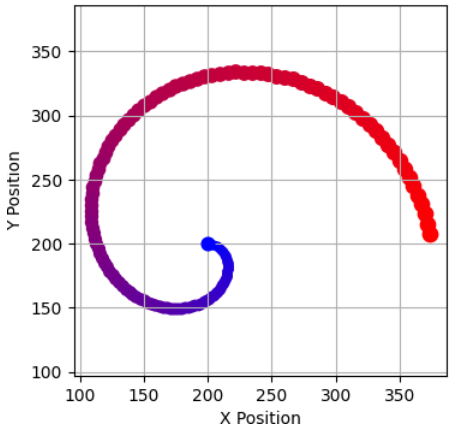


Figure S7. We prompt a VLM with a scatter plot representation of a motion trajectory. Each dot is the center position of the animated element and the color indicates time (transition from blue to red).

```
Generate 5 animations to the prompt, each within a separate ```javascript ``` tag.
Each animation must include a numeric probability value as a comment within its code block.
Please sample at random from the tails of the distribution, such that the probability of each response is less than 0.10.
```

E.4. Verifying Motion Trajectories with a VLM

Our experiments use two VLMs (GPT-4.1 and GPT-5) as baseline verification methods, and we provide details here on our prompting approach. We represent the motion trajectory center point time series data of animation as a scatter plot where the color of each dot transitions from blue to red to indicate the passage of time (Figure S7).

We prompt a VLM with a system message asking it to output a true/false label indicating whether a trajectory animation follows a trajectory prompt or not, with instructions on how to read the scatter plot. We then add a user message containing the motion trajectory prompt and the plot.

```
You are an expert in evaluating how well motion trajectories follow given prompts. Given a plot of a motion trajectory, your task is to assess whether the trajectory follows the prompt (True or False). Blue indicates the beginning of the trajectory and red indicates the end of the trajectory. The color transitions from blue to red as the trajectory progresses across time.

Please output your response as a JSON object with the following format:
```json
{
    "<trajectory_id (the index of the trajectory file)>": 0 or 1, # 0 means False, 1 means True
}
```
```

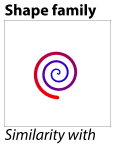
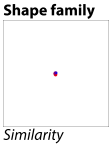
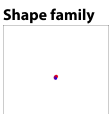
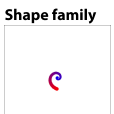
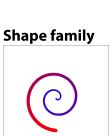
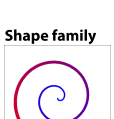
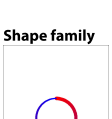
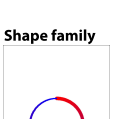
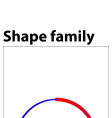
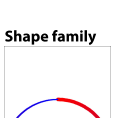
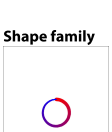
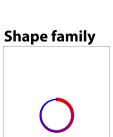
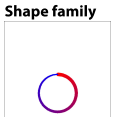
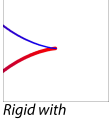
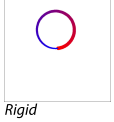
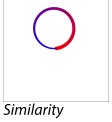
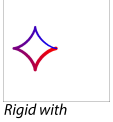
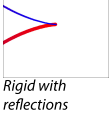
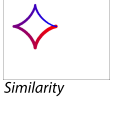
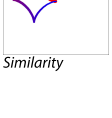
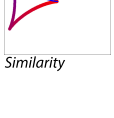
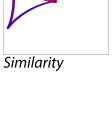
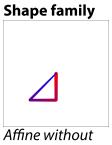
Shape family	Text prompt 1	Shape family	Text prompt 2	Shape family	Text prompt 3	Shape family	Text prompt 4
 *Similarity with reflections*	Animate the blue circle to move along a path shaped like an archimedean spiral (initial radius should be 0 and move outward from the scene center). Complete 1 turn of the archimedean spiral.	 *Similarity*	Animate the blue circle to move along a path shaped like an archimedean spiral (initial radius should be 0 and move outward from the scene center). Complete 1 turn of the archimedean spiral. Traverse the path in a counterclockwise manner.	 *Similarity*	Animate the blue circle to move along a path shaped like an archimedean spiral (initial radius should be 0 and move outward from the scene center). Complete 1 turn of the archimedean spiral. Traverse the path in a clockwise manner.	 *Similarity with reflections*	Animate the blue circle to move along a path shaped like an archimedean spiral (initial radius should be 0 and move outward from the scene center). Complete 2 turns of the archimedean spiral.
Shape family	**Text prompt 6**	**Shape family**	**Text prompt 7**	**Shape family**	**Text prompt 8**	**Shape family**	**Text prompt 5**
 *Similarity*	Animate the blue circle to move along a path shaped like an archimedean spiral (initial radius should be 0 and move outward from the scene center). Complete 2 turns of the archimedean spiral. Traverse the path in a clockwise manner.	 *Similarity with reflections*	Animate the blue circle to move along a path shaped like an archimedean spiral (initial radius should be 0 and move outward from the scene center). Complete 3 turns of the archimedean spiral.	 *Similarity*	Animate the blue circle to move along a path shaped like a logarithmic spiral (initial radius should be 1 and growth rate should be 0.3. move outward from the scene center). Complete 1 turn of the logarithmic spiral. Traverse the path in a counterclockwise manner.	 *Similarity*	Animate the blue circle to move along a path shaped like an archimedean spiral (initial radius should be 0 and move outward from the scene center). Complete 2 turns of the archimedean spiral. Traverse the path in a counterclockwise manner.
Shape family	**Text prompt 9**	**Shape family**	**Text prompt 10**	**Shape family**	**Text prompt 11**	**Shape family**	**Text prompt 12**
 *Similarity*	Animate the blue circle to move along a path shaped like a logarithmic spiral (initial radius should be 1 and growth rate should be 0.3. move outward from the scene center). Complete 1 turn of the logarithmic spiral. Traverse the path in a clockwise manner.	 *Similarity*	Animate the blue circle to move along a path shaped like a logarithmic spiral (initial radius should be 1 and growth rate should be 0.3. move outward from the scene center). Complete 2 turns of the logarithmic spiral. Traverse the path in a counterclockwise manner.	 *Similarity*	Animate the blue circle to move along a path shaped like a logarithmic spiral (initial radius should be 1 and growth rate should be 0.3. move outward from the scene center). Complete 2 turns of the logarithmic spiral. Traverse the path in a clockwise manner.	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like an archimedean spiral (initial radius should be 0 and move outward from the scene center). Complete 2 turns of the archimedean spiral. The distance between each turn should be 30.
Shape family	**Text prompt 13**	**Shape family**	**Text prompt 14**	**Shape family**	**Text prompt 15**	**Shape family**	**Text prompt 16**
 *Rigid with reflections*	Animate the blue circle to move along a path shaped like an archimedean spiral (initial radius should be 0 and move outward from the scene center). Complete 2 turns of the archimedean spiral. The distance between each turn should be 60.	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like an archimedean spiral (initial radius should be 0 and move outward from the scene center). Complete 2 turns of the archimedean spiral. The distance between each turn should be 90.	 *Similarity with reflections*	Animate the blue circle to move along a path shaped like a circle.	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a circle with a radius of 100.
Shape family	**Text prompt 17**	**Shape family**	**Text prompt 18**	**Shape family**	**Text prompt 19**	**Shape family**	**Text prompt 20**
 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a circle with a radius of 150.	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a circle with a radius of 200.	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a circle with a radius of 50.	 *Rigid*	Animate the blue circle to move along a path shaped like a circle with a radius of 60. Traverse the path in a counterclockwise manner.
Shape family	**Text prompt 21**	**Shape family**	**Text prompt 22**	**Shape family**	**Text prompt 24**	**Shape family**	**Text prompt 26**
 *Rigid*	Animate the blue circle to move along a path shaped like a circle with a radius of 60. Traverse the path in a clockwise manner.	 *Rigid*	Animate the blue circle to move along a path shaped like a circle with a radius of 70. Traverse the path in a counterclockwise manner.	 *Similarity*	Animate the blue circle to move along a path shaped like a circle. Traverse the path in a counterclockwise manner.	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like an astroid (four-cusped hypocycloid). The 'a' parameter of the astroid should be 60.
Shape family	**Text prompt 28**	**Shape family**	**Text prompt 23**	**Shape family**	**Text prompt 25**	**Shape family**	**Text prompt 27**
 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a deltoid (three-cusped hypocycloid). The 'a' parameter of the deltoid should be 60.	 *Rigid*	Animate the blue circle to move along a path shaped like a circle with a radius of 70. Traverse the path in a clockwise manner.	 *Similarity*	Animate the blue circle to move along a path shaped like a circle. Traverse the path in a clockwise manner.	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like an astroid (four-cusped hypocycloid). The 'a' parameter of the astroid should be 80.
Shape family	**Text prompt 29**	**Shape family**	**Text prompt 30**	**Shape family**	**Text prompt 31**	**Shape family**	**Text prompt 32**
 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a deltoid (three-cusped hypocycloid). The 'a' parameter of the deltoid should be 80.	 *Similarity with reflections*	Animate the blue circle to move along a path shaped like an astroid (four-cusped hypocycloid).	 *Similarity with reflections*	Animate the blue circle to move along a path shaped like a deltoid (three-cusped hypocycloid).	 *Similarity*	Animate the blue circle to move along a path shaped like an astroid (four-cusped hypocycloid). Traverse the path in a counterclockwise manner.
Shape family	**Text prompt 33**	**Shape family**	**Text prompt 34**	**Shape family**	**Text prompt 35**	**Shape family**	**Text prompt 36**
 *Similarity*	Animate the blue circle to move along a path shaped like an astroid (four-cusped hypocycloid). Traverse the path in a clockwise manner.	 *Similarity*	Animate the blue circle to move along a path shaped like a deltoid (three-cusped hypocycloid). Traverse the path in a counterclockwise manner.	 *Similarity*	Animate the blue circle to move along a path shaped like a deltoid (three-cusped hypocycloid). Traverse the path in a clockwise manner.	 *Affine without skew*	Animate the blue circle to move along a path shaped like an isosceles triangle.

Figure S8. Motion trajectory benchmark: prompt 1–36 with ground truth shape families.

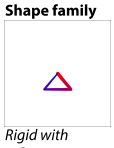
Shape family



Affine without skew

Text prompt 37
Animate the blue circle to move along a path shaped like a right triangle.

Shape family



Rigid with reflections

Text prompt 38
Animate the blue circle to move along a path shaped like an isosceles triangle with a width of 100 and a height of 60.

Shape family

Rigid with reflections

Text prompt 39
Animate the blue circle to move along a path shaped like an isosceles triangle with a width of 100 and a height of 80.

Shape family

Rigid with reflections

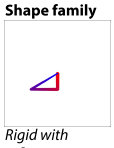
Text prompt 40
Animate the blue circle to move along a path shaped like an isosceles triangle with a width of 50 and a height of 60.

Shape family

Rigid with reflections

Text prompt 41
Animate the blue circle to move along a path shaped like an isosceles triangle with a width of 50 and a height of 80.

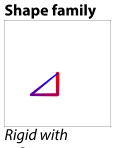
Shape family



Rigid with reflections

Text prompt 42
Animate the blue circle to move along a path shaped like a right triangle with a width of 100 and a height of 60.

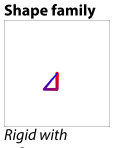
Shape family



Rigid with reflections

Text prompt 43
Animate the blue circle to move along a path shaped like a right triangle with a width of 100 and a height of 80.

Shape family



Rigid with reflections

Text prompt 44
Animate the blue circle to move along a path shaped like a right triangle with a width of 50 and a height of 60.

Shape family

Rigid with reflections

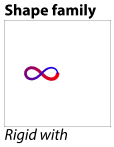
Text prompt 45
Animate the blue circle to move along a path shaped like a right triangle with a width of 50 and a height of 80.

Shape family

Affine

Text prompt 46
Animate the blue circle to move along a path shaped like a L shape (two sides of a triangle).

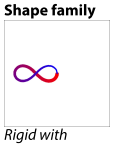
Shape family



Rigid with reflections

Text prompt 47
Animate the blue circle to move along a path shaped like a figure 8 shape (lemniscate of Bernoulli). The 'a' parameter of the figure 8 shape should be 60.

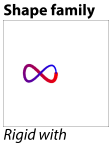
Shape family



Rigid with reflections

Text prompt 48
Animate the blue circle to move along a path shaped like a figure 8 shape (lemniscate of Bernoulli). The 'a' parameter of the figure 8 shape should be 80.

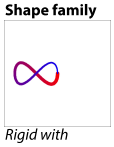
Shape family



Rigid with reflections

Text prompt 49
Animate the blue circle to move along a path shaped like a figure 8 shape (lemniscate of Gerono). The 'a' parameter of the figure 8 shape should be 60.

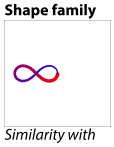
Shape family



Rigid with reflections

Text prompt 50
Animate the blue circle to move along a path shaped like a figure 8 shape (lemniscate of Gerono). The 'a' parameter of the figure 8 shape should be 80.

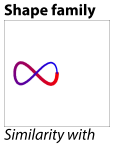
Shape family



Similarity with reflections

Text prompt 51
Animate the blue circle to move along a path shaped like a figure 8 shape (lemniscate of Bernoulli).

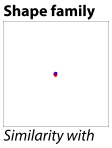
Shape family



Similarity with reflections

Text prompt 52
Animate the blue circle to move along a path shaped like a figure 8 shape (lemniscate of Gerono).

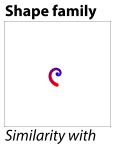
Shape family



Similarity with reflections

Text prompt 53
Animate the blue circle to move along a path shaped like a logarithmic spiral (initial radius should be 1 and growth rate should be 0.3. move outward from the scene center). Complete 1 turn of the logarithmic spiral.

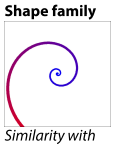
Shape family



Similarity with reflections

Text prompt 54
Animate the blue circle to move along a path shaped like a logarithmic spiral (initial radius should be 1 and growth rate should be 0.3. move outward from the scene center). Complete 2 turs of the logarithmic spiral.

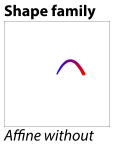
Shape family



Similarity with reflections

Text prompt 55
Animate the blue circle to move along a path shaped like a logarithmic spiral (initial radius should be 1 and growth rate should be 0.3. move outward from the scene center). Complete 3 turs of the logarithmic spiral.

Shape family



Affine without skew

Text prompt 56
Animate the blue circle to move along a path shaped like a full, symmetric parabola.

Shape family

Rigid with reflections

Text prompt 57
Animate the blue circle to move along a path shaped like a full, symmetric parabola with a height of 60. The horizontal extent of the full, symmetric parabola should be 100.

Shape family

Rigid with reflections

Text prompt 58
Animate the blue circle to move along a path shaped like a full, symmetric parabola with a height of 80. The horizontal extent of the full, symmetric parabola should be 100.

Shape family

Rigid with reflections

Text prompt 59
Animate the blue circle to move along a path shaped like a full, symmetric parabola with a height of 60. The horizontal extent of the full, symmetric parabola should be 150.

Shape family

Rigid with reflections

Text prompt 60
Animate the blue circle to move along a path shaped like a full, symmetric parabola with a height of 80. The horizontal extent of the full, symmetric parabola should be 150.

Shape family

Affine

Text prompt 61
Animate the blue circle to move along a path shaped like a parallelogram.

Shape family

Rigid with reflections

Text prompt 62
Animate the blue circle to move along a path shaped like an equilateral triangle with a side length of 100.

Shape family

Rigid with reflections

Text prompt 63
Animate the blue circle to move along a path shaped like an equilateral triangle with a side length of 150.

Shape family

Rigid with reflections

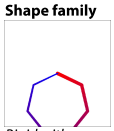
Text prompt 64
Animate the blue circle to move along a path shaped like an equilateral triangle with a side length of 175.

Shape family

Rigid with reflections

Text prompt 65
Animate the blue circle to move along a path shaped like an equilateral triangle with a side length of 50.

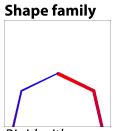
Shape family



Rigid with reflections

Text prompt 66
Animate the blue circle to move along a path shaped like a regular heptagon with a side length of 100.

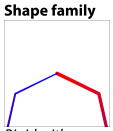
Shape family



Rigid with reflections

Text prompt 67
Animate the blue circle to move along a path shaped like a regular heptagon with a side length of 150.

Shape family



Rigid with reflections

Text prompt 68
Animate the blue circle to move along a path shaped like a regular heptagon with a side length of 175.

Shape family

Rigid with reflections

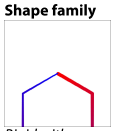
Text prompt 69
Animate the blue circle to move along a path shaped like a regular heptagon with a side length of 50.

Shape family

Rigid with reflections

Text prompt 70
Animate the blue circle to move along a path shaped like a regular hexagon with a side length of 100.

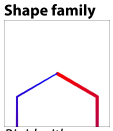
Shape family



Rigid with reflections

Text prompt 71
Animate the blue circle to move along a path shaped like a regular hexagon with a side length of 150.

Shape family



Rigid with reflections

Text prompt 72
Animate the blue circle to move along a path shaped like a regular hexagon with a side length of 175.

Figure S9. Motion trajectory benchmark: prompt 37–72 with ground truth shape families.

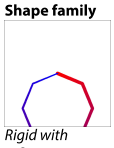
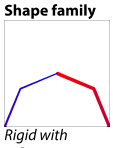
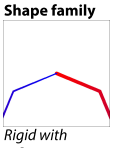
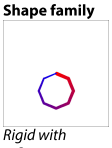
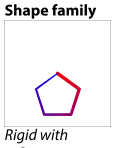
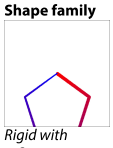
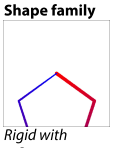
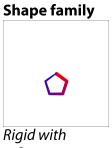
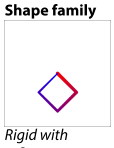
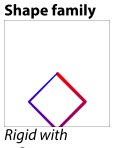
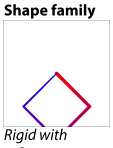
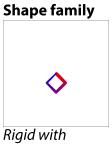
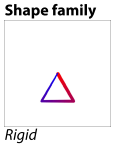
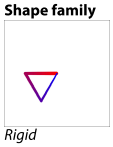
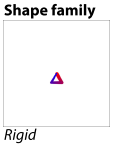
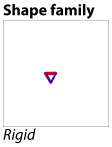
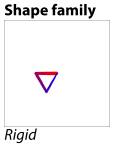
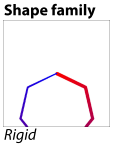
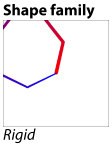
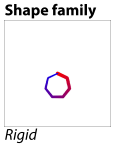
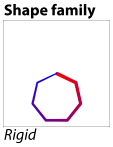
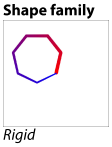
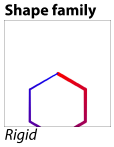
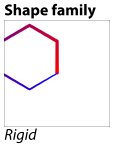
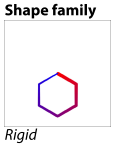
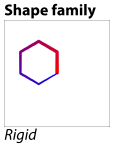
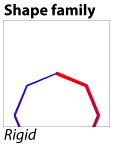
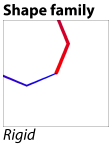
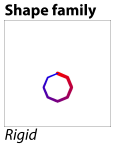
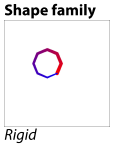
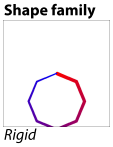
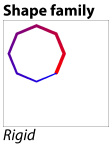
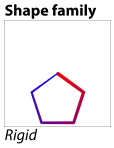
Shape family	Text prompt 73	Shape family	Text prompt 74	Shape family	Text prompt 75	Shape family	Text prompt 76
 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular hexagon with a side length of 50.	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular octagon with a side length of 100.	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular octagon with a side length of 150.	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular octagon with a side length of 175.
Shape family	**Text prompt 77**	**Shape family**	**Text prompt 78**	**Shape family**	**Text prompt 79**	**Shape family**	**Text prompt 80**
 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular octagon with a side length of 50.	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular pentagon with a side length of 100.	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular pentagon with a side length of 150.	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular pentagon with a side length of 175.
Shape family	**Text prompt 81**	**Shape family**	**Text prompt 82**	**Shape family**	**Text prompt 83**	**Shape family**	**Text prompt 84**
 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular pentagon with a side length of 50.	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a square with a side length of 100.	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a square with a side length of 150.	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a square with a side length of 175.
Shape family	**Text prompt 85**	**Shape family**	**Text prompt 86**	**Shape family**	**Text prompt 87**	**Shape family**	**Text prompt 88**
 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a square with a side length of 50.	 *Rigid*	Animate the blue circle to move along a path shaped like an equilateral triangle with a side length of 120. Traverse the path in a counterclockwise manner.	 *Rigid*	Animate the blue circle to move along a path shaped like an equilateral triangle with a side length of 120. Traverse the path in a clockwise manner.	 *Rigid*	Animate the blue circle to move along a path shaped like an equilateral triangle with a side length of 40. Traverse the path in a counterclockwise manner.
Shape family	**Text prompt 89**	**Shape family**	**Text prompt 90**	**Shape family**	**Text prompt 91**	**Shape family**	**Text prompt 92**
 *Rigid*	Animate the blue circle to move along a path shaped like an equilateral triangle with a side length of 40. Traverse the path in a clockwise manner.	 *Rigid*	Animate the blue circle to move along a path shaped like an equilateral triangle with a side length of 80. Traverse the path in a counterclockwise manner.	 *Rigid*	Animate the blue circle to move along a path shaped like an equilateral triangle with a side length of 80. Traverse the path in a clockwise manner.	 *Rigid*	Animate the blue circle to move along a path shaped like a regular heptagon with a side length of 120. Traverse the path in a counterclockwise manner.
Shape family	**Text prompt 93**	**Shape family**	**Text prompt 94**	**Shape family**	**Text prompt 95**	**Shape family**	**Text prompt 96**
 *Rigid*	Animate the blue circle to move along a path shaped like a regular heptagon with a side length of 120. Traverse the path in a clockwise manner.	 *Rigid*	Animate the blue circle to move along a path shaped like a regular heptagon with a side length of 40. Traverse the path in a counterclockwise manner.	 *Rigid*	Animate the blue circle to move along a path shaped like a regular heptagon with a side length of 40. Traverse the path in a clockwise manner.	 *Rigid*	Animate the blue circle to move along a path shaped like a regular heptagon with a side length of 80. Traverse the path in a counterclockwise manner.
Shape family	**Text prompt 97**	**Shape family**	**Text prompt 98**	**Shape family**	**Text prompt 99**	**Shape family**	**Text prompt 100**
 *Rigid*	Animate the blue circle to move along a path shaped like a regular heptagon with a side length of 80. Traverse the path in a clockwise manner.	 *Rigid*	Animate the blue circle to move along a path shaped like a regular hexagon with a side length of 120. Traverse the path in a counterclockwise manner.	 *Rigid*	Animate the blue circle to move along a path shaped like a regular hexagon with a side length of 120. Traverse the path in a clockwise manner.	 *Rigid*	Animate the blue circle to move along a path shaped like a regular hexagon with a side length of 40. Traverse the path in a counterclockwise manner.
Shape family	**Text prompt 101**	**Shape family**	**Text prompt 102**	**Shape family**	**Text prompt 103**	**Shape family**	**Text prompt 104**
 *Rigid*	Animate the blue circle to move along a path shaped like a regular hexagon with a side length of 40. Traverse the path in a clockwise manner.	 *Rigid*	Animate the blue circle to move along a path shaped like a regular hexagon with a side length of 80. Traverse the path in a counterclockwise manner.	 *Rigid*	Animate the blue circle to move along a path shaped like a regular hexagon with a side length of 80. Traverse the path in a clockwise manner.	 *Rigid*	Animate the blue circle to move along a path shaped like a regular octagon with a side length of 120. Traverse the path in a counterclockwise manner.
Shape family	**Text prompt 105**	**Shape family**	**Text prompt 106**	**Shape family**	**Text prompt 107**	**Shape family**	**Text prompt 108**
 *Rigid*	Animate the blue circle to move along a path shaped like a regular octagon with a side length of 120. Traverse the path in a clockwise manner.	 *Rigid*	Animate the blue circle to move along a path shaped like a regular octagon with a side length of 40. Traverse the path in a counterclockwise manner.	 *Rigid*	Animate the blue circle to move along a path shaped like a regular octagon with a side length of 40. Traverse the path in a clockwise manner.	 *Rigid*	Animate the blue circle to move along a path shaped like a regular octagon with a side length of 80. Traverse the path in a counterclockwise manner.

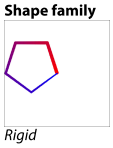
Figure S10. Motion trajectory benchmark: prompt 73–108 with ground truth shape families.

Shape family

Rigid

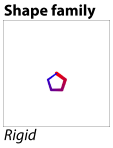
Text prompt 109
Animate the blue circle to move along a path shaped like a regular octagon with a side length of 80. Traverse the path in a clockwise manner.

Shape family

Rigid

Text prompt 110
Animate the blue circle to move along a path shaped like a regular pentagon with a side length of 120. Traverse the path in a counterclockwise manner.

Shape family

Rigid

Text prompt 111
Animate the blue circle to move along a path shaped like a regular pentagon with a side length of 120. Traverse the path in a clockwise manner.

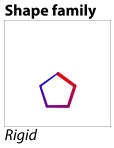
Shape family

Rigid

Text prompt 112
Animate the blue circle to move along a path shaped like a regular pentagon with a side length of 40. Traverse the path in a counterclockwise manner.

Shape family

Rigid

Text prompt 113
Animate the blue circle to move along a path shaped like a regular pentagon with a side length of 40. Traverse the path in a clockwise manner.

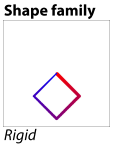
Shape family

Rigid

Text prompt 114
Animate the blue circle to move along a path shaped like a regular pentagon with a side length of 80. Traverse the path in a counterclockwise manner.

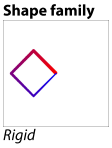
Shape family

Rigid

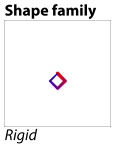
Text prompt 115
Animate the blue circle to move along a path shaped like a regular pentagon with a side length of 80. Traverse the path in a clockwise manner.

Shape family

Rigid

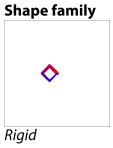
Text prompt 116
Animate the blue circle to move along a path shaped like a square with a side length of 120. Traverse the path in a counterclockwise manner.

Shape family

Rigid

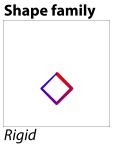
Text prompt 117
Animate the blue circle to move along a path shaped like a square with a side length of 120. Traverse the path in a clockwise manner.

Shape family

Rigid

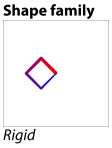
Text prompt 118
Animate the blue circle to move along a path shaped like a square with a side length of 40. Traverse the path in a counterclockwise manner.

Shape family

Rigid

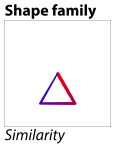
Text prompt 119
Animate the blue circle to move along a path shaped like a square with a side length of 40. Traverse the path in a clockwise manner.

Shape family

Rigid

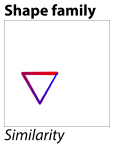
Text prompt 120
Animate the blue circle to move along a path shaped like a square with a side length of 80. Traverse the path in a counterclockwise manner.

Shape family

Rigid

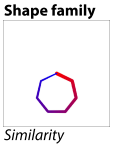
Text prompt 121
Animate the blue circle to move along a path shaped like a square with a side length of 80. Traverse the path in a clockwise manner.

Shape family

Similarity

Text prompt 122
Animate the blue circle to move along a path shaped like an equilateral triangle. Traverse the path in a counterclockwise manner.

Shape family

Similarity

Text prompt 123
Animate the blue circle to move along a path shaped like an equilateral triangle. Traverse the path in a clockwise manner.

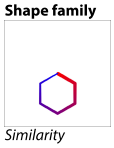
Shape family

Similarity

Text prompt 124
Animate the blue circle to move along a path shaped like a regular heptagon. Traverse the path in a counterclockwise manner.

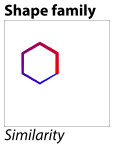
Shape family

Similarity

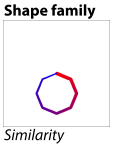
Text prompt 125
Animate the blue circle to move along a path shaped like a regular heptagon. Traverse the path in a clockwise manner.

Shape family

Similarity

Text prompt 126
Animate the blue circle to move along a path shaped like a regular hexagon. Traverse the path in a counterclockwise manner.

Shape family

Similarity

Text prompt 127
Animate the blue circle to move along a path shaped like a regular hexagon. Traverse the path in a clockwise manner.

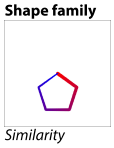
Shape family

Similarity

Text prompt 128
Animate the blue circle to move along a path shaped like a regular octagon. Traverse the path in a counterclockwise manner.

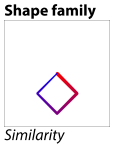
Shape family

Similarity

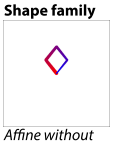
Text prompt 129
Animate the blue circle to move along a path shaped like a regular octagon. Traverse the path in a clockwise manner.

Shape family

Similarity

Text prompt 130
Animate the blue circle to move along a path shaped like a regular pentagon. Traverse the path in a counterclockwise manner.

Shape family

Similarity

Text prompt 132
Animate the blue circle to move along a path shaped like a square. Traverse the path in a counterclockwise manner.

Shape family

Affine without skew

Text prompt 134
Animate the blue circle to move along a path shaped like a rhombus.

Shape family

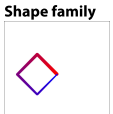
Similarity with reflections

Text prompt 136
Animate the blue circle to move along a path shaped like an ellipse with a 16:9 width to height ratio.

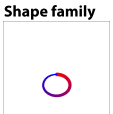
Shape family

Similarity

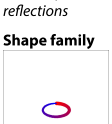
Text prompt 131
Animate the blue circle to move along a path shaped like a regular pentagon. Traverse the path in a clockwise manner.

Shape family

Similarity

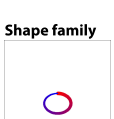
Text prompt 133
Animate the blue circle to move along a path shaped like a square. Traverse the path in a clockwise manner.

Shape family

Affine without skew

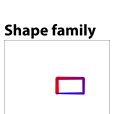
Text prompt 135
Animate the blue circle to move along a path shaped like an ellipse.

Shape family

Similarity with reflections

Text prompt 137
Animate the blue circle to move along a path shaped like an ellipse with a 2:1 width to height ratio.

Shape family

Similarity with reflections

Text prompt 138
Animate the blue circle to move along a path shaped like an ellipse with a 4:3 width to height ratio.

Shape family

Similarity with reflections

Text prompt 139
Animate the blue circle to move along a path shaped like a rectangle with a 16:9 width to height ratio.

Shape family

Similarity with reflections

Text prompt 140
Animate the blue circle to move along a path shaped like a rectangle with a 2:1 width to height ratio.

Shape family

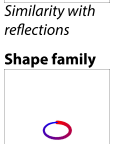
Similarity with reflections

Text prompt 141
Animate the blue circle to move along a path shaped like a rectangle with a 4:3 width to height ratio.

Shape family

Affine without skew

Text prompt 142
Animate the blue circle to move along a path shaped like a rectangle.

Shape family

Rigid with reflections

Text prompt 143
Animate the blue circle to move along a path shaped like an ellipse with a width of 100 and a height of 60.

Shape family

Rigid with reflections

Text prompt 144
Animate the blue circle to move along a path shaped like an ellipse with a width of 100 and a height of 80.

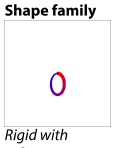
Figure S11. Motion trajectory benchmark: prompt 109–144 with ground truth shape families.

Shape family

Rigid with reflections

Text prompt 145
Animate the blue circle to move along a path shaped like an ellipse with a width of 50 and a height of 60.

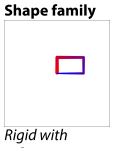
Shape family



Rigid with reflections

Text prompt 146
Animate the blue circle to move along a path shaped like an ellipse with a width of 50 and a height of 80.

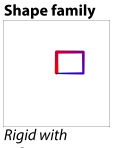
Shape family



Rigid with reflections

Text prompt 147
Animate the blue circle to move along a path shaped like a rectangle with a width of 100 and a height of 60.

Shape family



Rigid with reflections

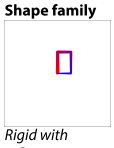
Text prompt 148
Animate the blue circle to move along a path shaped like a rectangle with a width of 100 and a height of 80.

Shape family

Rigid with reflections

Text prompt 149
Animate the blue circle to move along a path shaped like a rectangle with a width of 50 and a height of 60.

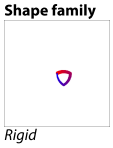
Shape family



Rigid with reflections

Text prompt 150
Animate the blue circle to move along a path shaped like a rectangle with a width of 50 and a height of 80.

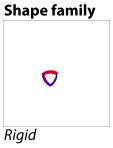
Shape family



Rigid

Text prompt 151
Animate the blue circle to move along a path shaped like a reuleaux triangle with a width of 50. Traverse the path in a counterclockwise manner.

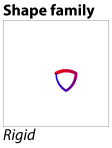
Shape family



Rigid

Text prompt 152
Animate the blue circle to move along a path shaped like a reuleaux triangle with a width of 50. Traverse the path in a clockwise manner.

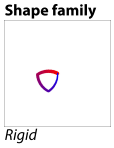
Shape family



Rigid

Text prompt 153
Animate the blue circle to move along a path shaped like a reuleaux triangle with a width of 75. Traverse the path in a counterclockwise manner.

Shape family



Rigid

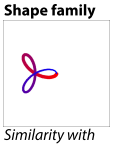
Text prompt 154
Animate the blue circle to move along a path shaped like a reuleaux triangle with a width of 75. Traverse the path in a clockwise manner.

Shape family

Similarity with reflections

Text prompt 155
Animate the blue circle to move along a path shaped like a reuleaux triangle.

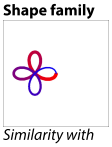
Shape family



Similarity with reflections

Text prompt 156
Animate the blue circle to move along a path shaped like a 3-petal rose (trifolium).

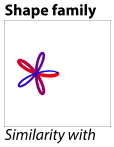
Shape family



Similarity with reflections

Text prompt 157
Animate the blue circle to move along a path shaped like a 4-petal rose (quadrifolium).

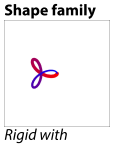
Shape family



Similarity with reflections

Text prompt 158
Animate the blue circle to move along a path shaped like a 5-petal rose (pentafolium).

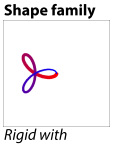
Shape family



Rigid with reflections

Text prompt 159
Animate the blue circle to move along a path shaped like a 3-petal rose (trifolium). The 'a' parameter of the 3-petal rose should be 60.

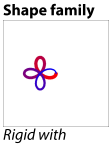
Shape family



Rigid with reflections

Text prompt 160
Animate the blue circle to move along a path shaped like a 3-petal rose (trifolium). The 'a' parameter of the 3-petal rose should be 80.

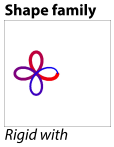
Shape family



Rigid with reflections

Text prompt 161
Animate the blue circle to move along a path shaped like a 4-petal rose (quadrifolium). The 'a' parameter of the 4-petal rose should be 60.

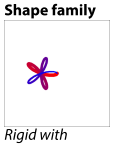
Shape family



Rigid with reflections

Text prompt 162
Animate the blue circle to move along a path shaped like a 4-petal rose (quadrifolium). The 'a' parameter of the 4-petal rose should be 80.

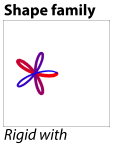
Shape family



Rigid with reflections

Text prompt 163
Animate the blue circle to move along a path shaped like a 5-petal rose (pentafolium). The 'a' parameter of the 5-petal rose should be 60.

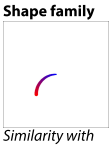
Shape family



Rigid with reflections

Text prompt 164
Animate the blue circle to move along a path shaped like a 5-petal rose (pentafolium). The 'a' parameter of the 5-petal rose should be 80.

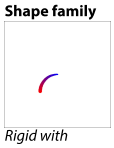
Shape family



Similarity with reflections

Text prompt 165
Animate the blue circle to move along a path shaped like a quarter-circle (a quarter of a circle's circumference).

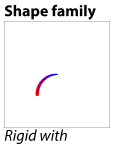
Shape family



Rigid with reflections

Text prompt 166
Animate the blue circle to move along a path shaped like a quarter-circle (a quarter of a circle's circumference) with a radius of 65.

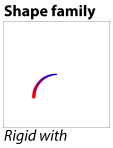
Shape family



Rigid with reflections

Text prompt 167
Animate the blue circle to move along a path shaped like a quarter-circle (a quarter of a circle's circumference) with a radius of 75.

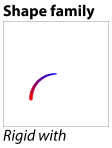
Shape family



Rigid with reflections

Text prompt 168
Animate the blue circle to move along a path shaped like a quarter-circle (a quarter of a circle's circumference) with a radius of 85.

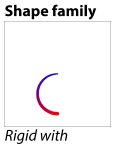
Shape family



Rigid with reflections

Text prompt 169
Animate the blue circle to move along a path shaped like a quarter-circle (a quarter of a circle's circumference) with a radius of 95.

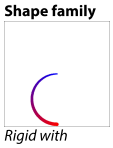
Shape family



Rigid with reflections

Text prompt 171
Animate the blue circle to move along a path shaped like a semi-circle (half of a circle's circumference) with a radius of 75.

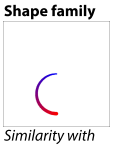
Shape family



Rigid with reflections

Text prompt 173
Animate the blue circle to move along a path shaped like a semi-circle (half of a circle's circumference) with a radius of 95.

Shape family



Similarity with reflections

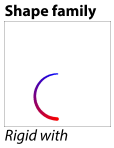
Text prompt 174
Animate the blue circle to move along a path shaped like a semi-circle (half of a circle's circumference).

Shape family

Rigid with reflections

Text prompt 170
Animate the blue circle to move along a path shaped like a semi-circle (half of a circle's circumference) with a radius of 65.

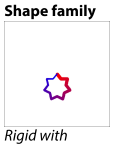
Shape family



Rigid with reflections

Text prompt 172
Animate the blue circle to move along a path shaped like a semi-circle (half of a circle's circumference) with a radius of 85.

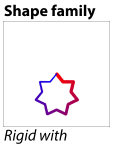
Shape family



Rigid with reflections

Text prompt 175
Animate the blue circle to move along a path shaped like a regular heptagram {7/2} (without the internal crossovers) with an outer radius of 50. Only move along the outline of the regular heptagram {7/2} (no path crossovers).

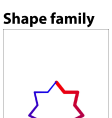
Shape family



Rigid with reflections

Text prompt 176
Animate the blue circle to move along a path shaped like a regular heptagram {7/2} (without the internal crossovers) with an outer radius of 80. Only move along the outline of the regular heptagram {7/2} (no path crossovers).

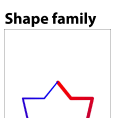
Shape family



Rigid with reflections

Text prompt 177
Animate the blue circle to move along a path shaped like a regular heptagram {7/2} (without the internal crossovers) with each line segment being 50 px long. Only move along the outline of the regular heptagram {7/2} (no path crossovers).

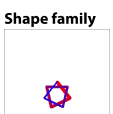
Shape family



Rigid with reflections

Text prompt 178
Animate the blue circle to move along a path shaped like a regular heptagram {7/2} (without the internal crossovers) with each line segment being 80 px long. Only move along the outline of the regular heptagram {7/2} (no path crossovers).

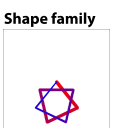
Shape family



Rigid with reflections

Text prompt 179
Animate the blue circle to move along a path shaped like a regular heptagram {7/2} (with self-intersecting path segments) with an outer radius of 50.

Shape family



Rigid with reflections

Text prompt 180
Animate the blue circle to move along a path shaped like a regular heptagram {7/2} (with self-intersecting path segments) with an outer radius of 80.

Figure S12. Motion trajectory benchmark: prompt 145–180 with ground truth shape families.

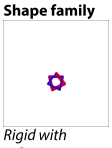
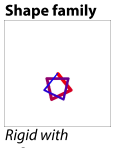
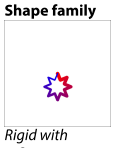
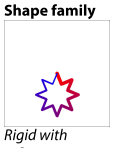
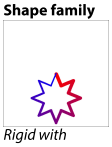
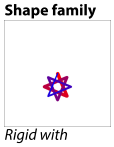
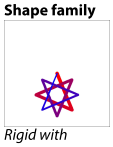
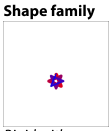
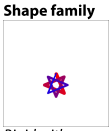
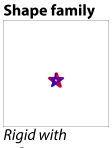
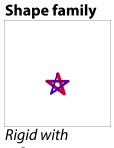
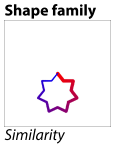
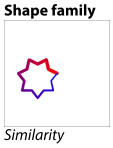
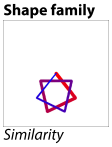
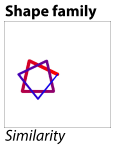
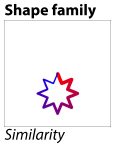
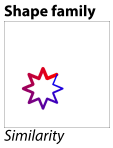
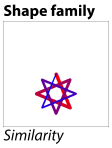
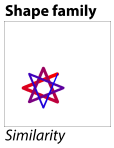
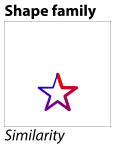
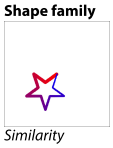
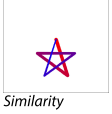
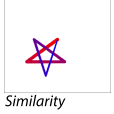
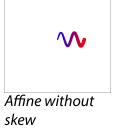
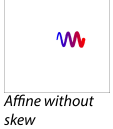
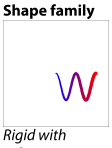
Shape family	Text prompt 181	Shape family	Text prompt 182	Shape family	Text prompt 183	Shape family	Text prompt 184
 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular heptagram {7/2} (with self-intersecting path segments) with each line segment being 50 px long.	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular heptagram {7/2} (with self-intersecting path segments) with each line segment being 80 px long.	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular octagram {8/3} (without the internal crossovers) with an outer radius of 50. Only move along the outline of the regular octagram {8/3} (no path crossovers).	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular octagram {8/3} (without the internal crossovers) with an outer radius of 80. Only move along the outline of the regular octagram {8/3} (no path crossovers).
Shape family	**Text prompt 185**	**Shape family**	**Text prompt 186**	**Shape family**	**Text prompt 187**	**Shape family**	**Text prompt 188**
 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular octagram {8/3} (without the internal crossovers) with each line segment being 50 px long. Only move along the outline of the regular octagram {8/3} (no path crossovers).	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular octagram {8/3} (without the internal crossovers) with each line segment being 80 px long. Only move along the outline of the regular octagram {8/3} (no path crossovers).	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular octagram {8/3} (with self-intersecting path segments) with an outer radius of 50.	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular octagram {8/3} (with self-intersecting path segments) with an outer radius of 80.
Shape family	**Text prompt 189**	**Shape family**	**Text prompt 191**	**Shape family**	**Text prompt 193**	**Shape family**	**Text prompt 194**
 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular octagram {8/3} (with self-intersecting path segments) with each line segment being 50 px long.	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular pentagram (without the internal crossovers) with an outer radius of 50. Only move along the outline of the regular pentagram (no path crossovers).	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular pentagram (without the internal crossovers) with each line segment being 50 px long. Only move along the outline of the regular pentagram (no path crossovers).	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular pentagram (without the internal crossovers) with each line segment being 80 px long. Only move along the outline of the regular pentagram (no path crossovers).
Shape family	**Text prompt 190**	**Shape family**	**Text prompt 192**	**Shape family**	**Text prompt 195**	**Shape family**	**Text prompt 196**
 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular octagram {8/3} (with self-intersecting path segments) with each line segment being 80 px long.	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular pentagram (without the internal crossovers) with an outer radius of 80. Only move along the outline of the regular pentagram (no path crossovers).	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular pentagram (with self-intersecting path segments) with an outer radius of 50.	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular pentagram (with self-intersecting path segments) with an outer radius of 80.
Shape family	**Text prompt 197**	**Shape family**	**Text prompt 198**	**Shape family**	**Text prompt 199**	**Shape family**	**Text prompt 200**
 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular pentagram (with self-intersecting path segments) with each line segment being 50 px long.	 *Rigid with reflections*	Animate the blue circle to move along a path shaped like a regular pentagram (with self-intersecting path segments) with each line segment being 80 px long.	 *Similarity*	Animate the blue circle to move along a path shaped like a regular heptagram {7/2} (without the internal crossovers). Only move along the outline of the regular heptagram {7/2} (no path crossovers). Traverse the path in a counterclockwise manner.	 *Similarity*	Animate the blue circle to move along a path shaped like a regular heptagram {7/2} (without the internal crossovers). Only move along the outline of the regular heptagram {7/2} (no path crossovers). Traverse the path in a clockwise manner.
Shape family	**Text prompt 201**	**Shape family**	**Text prompt 202**	**Shape family**	**Text prompt 203**	**Shape family**	**Text prompt 204**
 *Similarity*	Animate the blue circle to move along a path shaped like a regular heptagram {7/2} (with self-intersecting path segments). Traverse the path in a counterclockwise manner.	 *Similarity*	Animate the blue circle to move along a path shaped like a regular heptagram {7/2} (with self-intersecting path segments). Traverse the path in a clockwise manner.	 *Similarity*	Animate the blue circle to move along a path shaped like a regular octagram {8/3} (without the internal crossovers). Only move along the outline of the regular octagram {8/3} (no path crossovers). Traverse the path in a counterclockwise manner.	 *Similarity*	Animate the blue circle to move along a path shaped like a regular octagram {8/3} (without the internal crossovers). Only move along the outline of the regular octagram {8/3} (no path crossovers). Traverse the path in a clockwise manner.
Shape family	**Text prompt 205**	**Shape family**	**Text prompt 206**	**Shape family**	**Text prompt 207**	**Shape family**	**Text prompt 208**
 *Similarity*	Animate the blue circle to move along a path shaped like a regular octagram {8/3} (with self-intersecting path segments). Traverse the path in a counterclockwise manner.	 *Similarity*	Animate the blue circle to move along a path shaped like a regular octagram {8/3} (with self-intersecting path segments). Traverse the path in a clockwise manner.	 *Similarity*	Animate the blue circle to move along a path shaped like a regular pentagram (without the internal crossovers). Only move along the outline of the regular pentagram (no path crossovers). Traverse the path in a counterclockwise manner.	 *Similarity*	Animate the blue circle to move along a path shaped like a regular pentagram (without the internal crossovers). Only move along the outline of the regular pentagram (no path crossovers). Traverse the path in a clockwise manner.
Shape family	**Text prompt 209**	**Shape family**	**Text prompt 210**	**Shape family**	**Text prompt 211**	**Shape family**	**Text prompt 212**
 *Similarity*	Animate the blue circle to move along a path shaped like a regular pentagram (with self-intersecting path segments). Traverse the path in a counterclockwise manner.	 *Similarity*	Animate the blue circle to move along a path shaped like a regular pentagram (with self-intersecting path segments). Traverse the path in a clockwise manner.	 *Affine without skew*	Animate the blue circle to move along a path shaped like a cosine wave. Complete 1 period of the cosine wave.	 *Affine without skew*	Animate the blue circle to move along a path shaped like a cosine wave. Complete 2 periods of the cosine wave.
Shape family	**Text prompt 213**	**Shape family**	**Text prompt 214**	**Shape family**	**Text prompt 215**	**Shape family**	**Text prompt 216**
 *Affine without skew*	Animate the blue circle to move along a path shaped like a cosine wave. Complete 3 periods of the cosine wave.	 *Affine without skew*	Animate the blue circle to move along a path shaped like a sine wave. Complete 1 period of the sine wave.	 *Affine without skew*	Animate the blue circle to move along a path shaped like a sine wave. Complete 2 periods of the sine wave.	 *Affine without skew*	Animate the blue circle to move along a path shaped like a sine wave. Complete 3 periods of the sine wave.

Figure S13. Motion trajectory benchmark: prompt 181–216 with ground truth shape families.

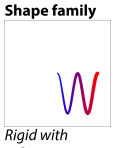
Shape family



Rigid with reflections

Text prompt 217
Animate the blue circle to move along a path shaped like a cosine wave with an amplitude of 50. Complete 2 periods of the cosine wave. The horizontal extent of the cosine wave should be 150.

Shape family



Rigid with reflections

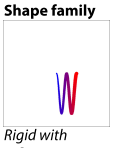
Text prompt 218
Animate the blue circle to move along a path shaped like a cosine wave with an amplitude of 75. Complete 2 periods of the cosine wave. The horizontal extent of the cosine wave should be 150.

Shape family

Rigid with reflections

Text prompt 219
Animate the blue circle to move along a path shaped like a cosine wave with an amplitude of 50. Complete 2 periods of the cosine wave. The horizontal extent of the cosine wave should be 75.

Shape family



Rigid with reflections

Text prompt 220
Animate the blue circle to move along a path shaped like a cosine wave with an amplitude of 75. Complete 2 periods of the cosine wave. The horizontal extent of the cosine wave should be 75.

Shape family

Rigid with reflections

Text prompt 221
Animate the blue circle to move along a path shaped like a sine wave with an amplitude of 50. Complete 2 periods of the sine wave. The horizontal extent of the sine wave should be 150.

Shape family

Rigid with reflections

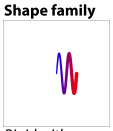
Text prompt 222
Animate the blue circle to move along a path shaped like a sine wave with an amplitude of 75. Complete 2 periods of the sine wave. The horizontal extent of the sine wave should be 150.

Shape family

Rigid with reflections

Text prompt 223
Animate the blue circle to move along a path shaped like a sine wave with an amplitude of 50. Complete 2 periods of the sine wave. The horizontal extent of the sine wave should be 75.

Shape family



Rigid with reflections

Text prompt 224
Animate the blue circle to move along a path shaped like a sine wave with an amplitude of 75. Complete 2 periods of the sine wave. The horizontal extent of the sine wave should be 75.

Figure S14. Motion trajectory benchmark: prompt 217–224 with ground truth shape families.

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