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Original Article

Human Responses to the Relationships between Object Shapes and Movements in the Context of Visual Attention and S-R Compatibility

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Abstract: The noninverted triangle is generally regarded as more stable than the inverted one. The perception of stability/instability may vary when it is moving. Triangles moving in their pointing direction might be perceived as naturally moving and especially stable, which can lead to preferred and facilitated processing. We conducted three experiments in which noninverted and inverted triangles moved upwards or downwards. The results showed that participants preferred triangles moving in their pointing direction over those moving against their pointing direction and were faster in selecting and finding triangles with compatible than incompatible movement. These results can be explained by stimulus-response compatibility, which means that responses to stimuli are faster and more accurate when the properties of the stimulus and response are compatible than when they are not. The results help improve human-object interactions in different contexts like car driving, user interfaces, or virtual reality.

Keywords: Vision, Response to moving objects, Directionality, Inverted triangle, Stimulus-response compatibility

1. Introduction

Inverted triangles (▼) are easily noticeable shapes and therefore, often used in traffic signs. As the word "inverted" suggests, its shape is perceived as unstable since gravity would make it fall (Barnett-Cowan et al., 2011; Cholewiak et al., 2013; Firestone & Keil, 2016; Lupo & Barnett-Cowan, 2015). In contrast, noninverted triangles (▲) are perceived as stable, and there is evidence that the perceived stability or instability influences visual search efficiency (Yang & Wolfe, 2020). However, the perception of stability/instability may vary when it is moving. For example, a moving inverted triangle might not be perceived as unstable at all since it does not seem at a tipping point when moving. Furthermore, the movement direction might interact with inherent features of shapes like pointing direction to influence its perception and responses toward such stimuli (Hafri & Firestone, 2021). In this study, we used noninverted isosceles triangles (▲) and inverted isosceles triangles moving upwards and downwards. Importantly, while equilateral triangles have no inherent, unambiguous pointing direction (Attneave, 1968; Palmer, 1980), isosceles triangles are likely perceived as pointing upward (▲) or downward (▼) with regard to the direction of gravity (Clément & Bukley, 2008; Hulleman & Humphreys, 2004). Thus, the moving direction can either be compatible with the pointing direction (e.g., an inverted triangle [▼] moving downward) or incompatible (e.g., an inverted triangle [▼] moving upwards).

Since triangles with compatible movements appear stable and moving in their natural direction, such objects might be preferred by humans and processed faster. To test this hypothesis, we conducted three experiments. In Experiment 1, participants should click on noninverted and inverted triangles moving upwards or downwards. If participants prefer triangles with compatible movement, they should click on more compatible than incompatible triangles within a certain time. Additionally, we instructed participants to click only on inverted or noninverted triangles moving up- or downwards to test if triangles with compatible movement can be found and clicked on faster than incompatibly moving triangles (Experiments 2 and 3). Such results would support the hypothesis that stimuli with compatible pointing and moving directions can be processed faster than other stimuli. The reason for such a compatibility or congruency effect might be the improved attentional capture or a stimulus-response (S-R) compatibility (Simon and Wolf, 1963; Richez et al., 2016; Haddad et al., 2024; Shi et al., 2023) effect due to the matching of pointing direction and response direction, when the mouse cursor follows the target. The results of this study help improve human-object interactions in different contexts like car driving, user interfaces, or virtual reality.

The used stimuli are basic shapes often used in psychological research to avoid possible confounding factors that often occur with more complex stimuli (e.g., differences in contrasts, different meanings between participants). The isosceles triangles are chosen as they have an inherent pointing direction (in contrast to equilateral triangles) so that the relationship between pointing direction and movement can be investigated. Additionally, we used isosceles triangle because equilateral triangles do not have an inherent pointing direction.

2. Experiment 1

In the first experiment, we investigated how the compatibility between pointing and movement direction influenced performance when participants had to search for and click on the moving triangles. If this compatibility facilitates perception, we expect better performance in compatible trials compared to incompatible ones.

2.1 Methods

2.1.1 Participants

Thirteen participants (3 men, 10 women) took part in the experiment. All the respondents were junior and senior students of Kansai University and the age range is 20 to 22 years. They did not receive any reward.

2.1.2 Apparatus

The experiment was conducted in a dimly lit room on a notebook with a screen size of 17 cm (Height) × 26 cm (Width), see Figure 1. The viewing distance to the screen was approximately 45 cm, as mentioned in the caption. The window size was determined based on the ease of response of the respondents. If the screen is too large, it is difficult for respondents to click on the randomly appearing and moving triangles. The whole experiment lasted about 10 min.

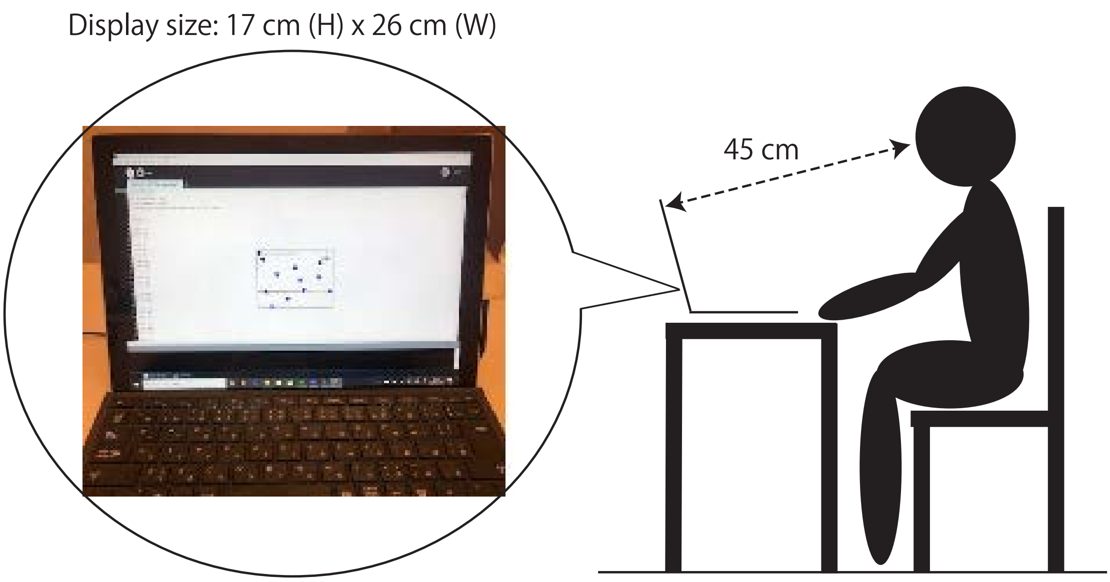
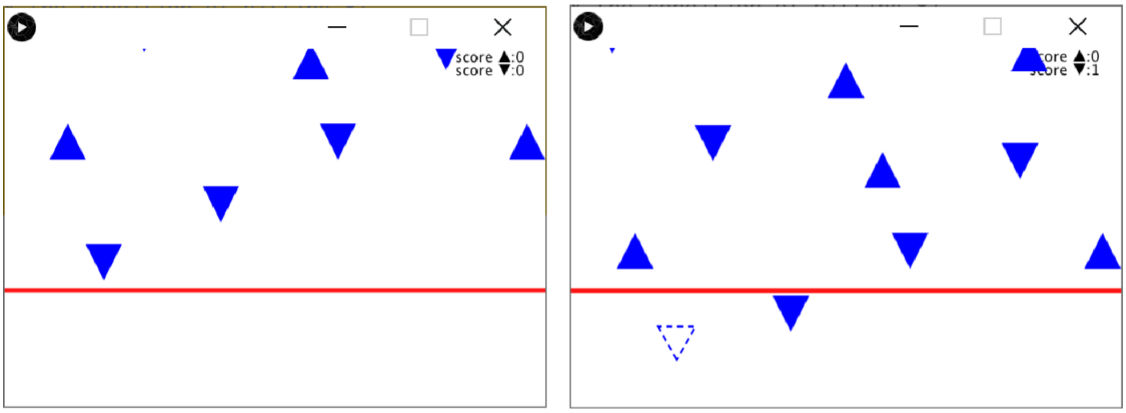


Figure 1: Arrangement of the experimental equipment and participant. The screen's tilt is controlled to face the participant’s eyes and keep the distance approximately 45 cm.

2.1.3 Design and procedure

Ten noninverted triangles (▲) and ten inverted triangles (▼) moved simultaneously from top to bottom or bottom to top. The participants were instructed to click with the mouse cursor on as many triangles as possible (regardless of pointing direction) after the triangles crossed a red line and before the triangles disappeared at the edge of the window. Figure 2 shows the case where the triangles moved from top to bottom. The red line is shifted toward the bottom of the window to increase the difficulty of the task. After the participants clicked on a triangle that crossed the red line, the triangles disappeared (see Figure 2 (b)). The experiment started with the triangles moving downwards, followed by a second trial, where the triangles moved upwards (see Figure 3). All the experiments started with always with the downward movement since participants might be more familiar with this movement direction from video games (e.g., Tetris). The respondents did not receive a practical session. Video games where the player captures falling objects are well known, and playing the tasks in Experiments 1 to 3 is not difficult because the speed of moving is not so fast.



(a) (b)

Figure 2: Procedure in Experiment 1 in the case where the triangles are moving downward. Only clicks below the red line were effective. (a) Before clicking. (b) The successfully clicked object disappeared (indicated by a dashed triangle), and the number of successful clicks was accumulated.

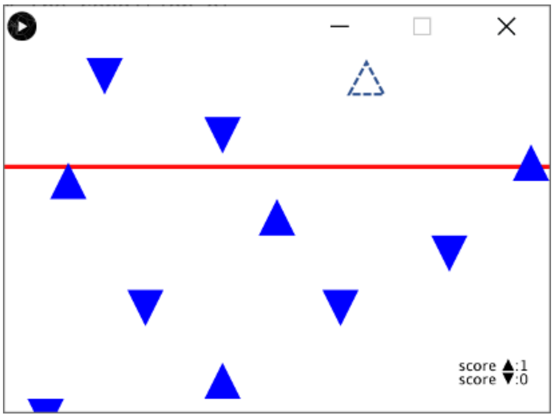


Figure 3: Procedure in Experiment 1 in the case where the triangles are moving upward. The successfully clicked object above the red line disappeared, and the number of successful clicks was accumulated.

2.1.4 Stimuli

The moving triangles were displayed in a separate window with an area of 4 cm (Height) × 6 cm (Width). The length of both slant edges of the isosceles triangles was 0.4 cm. The triangle was inscribed within a square whose edge is common with triangles' bottom or top edge, respectively. A click was recorded as successful if it occurred within the area of the circumscribing square. That is, it was not necessary to click exactly on the visible area of the triangle to produce a successful click. Thus, the clickable area was always the same when a triangle crossed the red line or started disappearing at the edge of the window independent of the triangles' orientation and movement direction. The triangles moved at 2 mm/sec.

2.1.5 Data analysis

We calculated an evaluation score for each participant per movement direction (upwards and downwards) by subtracting the number of successful clicks on inverted triangles (▼) from the number of successful clicks on noninverted triangles (▲). Therefore, a positive score indicates more successful clicks on noninverted triangles compared to inverted ones and vice versa for negative scores (more successful clicks on inverted triangles than noninverted ones). For comparison between groups, we used one-sample *t* tests to analyze whether the difference between groups is different from zero.

2.2 Results

When the triangles moved from top to bottom, the average evaluation score among the participants was −1.23; 95% CI [−∞, −0.32], SD = 1.83. This is a standardized effect $d = -0.63$ [−1.27, −0.06][1] . We conducted a one-side paired *t* test under the null hypothesis, "the score higher than zero," and the alternative hypothesis, "the score is smaller than zero." The obtained $t(12) = -2.42$, $p = .016$, and the alternative hypothesis was accepted at the significance level of 5%. Consequently, the inverted triangles (▼) were significantly easier to click on than the noninverted triangles (▲) when the triangles moved downwards. The opposite results occurred when the objects moved from bottom to top (upwards): The average evaluation score was +1.54 [0.44, ∞], SD = 2.22, d = 0.95 [0.07, 1.29]. The null hypothesis is set to "the score is smaller than zero" and the alternative hypothesis to "the score is larger than zero," and the obtained $t(12) = 2.5$, $p = .014$, and the alternative hypothesis was accepted at the significance level of 5%. It indicates that the noninverted triangles (▲) were significantly easier to click on than the inverted triangles (▼).

2.3 Discussion

In Experiment 1, participants had to click on as many moving triangles as possible, regardless of the triangles' pointing direction. The results showed that triangles moving in the same direction as their pointing direction (triangles with compatible movement) were clicked more often than those moving against their pointing direction (triangles with incompatible movement). Since participants were instructed to click on all triangles, this result could indicate that participants could perceive and respond better to the compatible triangles. However, it is also possible that participants preferentially searched for and clicked on the compatible triangles. Thus, in Experiment 2, participants had to click only on inverted or noninverted triangles.

3. Experiment 2

As in Experiment 1, ten noninverted triangles (▲) and ten inverted triangles (▼) moved downward or upward. However, this time participants were instructed to click only on one type of triangle, either inverted or noninverted. Each participant completed two trials for each movement direction of the triangles. First, they had to click on the noninverted triangles (▲), and then, in the second trial, on the inverted triangles (▼).

3.1 Methods

The same participants of Experiment 1 were tested under the same conditions. Experiment 2 was performed consecutively after Experiment 1. A learning effect may occur, however, the condition is the same for all the participants. The design and procedure were the same as in Experiment 1; however, the moving speed was increased to 3 mm/sec. It was faster than that of Experiment 1 because the number of objects to be clicked was reduced to half of those in Experiment 1. With the same speed as in Experiment 1, all ten triangles could be easily clicked in each trial.

3.2 Results

The evaluation score was calculated as in Experiment 1 (number of successful clicks on noninverted triangles (▲) at the first trial minus the number of successful clicks on inverted triangles (▼) at the second trial) for each moving direction. The average score among the participants was −1.69 [−∞, −1.07], SD = 1.25, $d = -1.27$ [−2.10, −0.58] when the objects moved downward and +0.92 [0.50, ∞], SD = 0.86, d = 1.00 [0.37, 1.75] when the objects moved upward. We conducted the same *t* tests as for Experiment 1 and the results were similar. When the target triangles moved upwards, the evaluation score was significantly above zero, $t(12) = 3.86$, $p = .001$. However, when they moved downward, the score was significantly below zero, $t(12) = -4.88$, $p < .001$.

3.3 Discussion

In Experiment 2, we replicated the results of Experiment 1: Triangles with compatible movement directions were significantly easier to click on compared to triangles with incompatible movement directions. However, this time we can exclude that the results occurred due to preferred search strategies instead of facilitated processing of compatible stimuli. To further investigate whether triangles with compatible movements are processed better, we conducted a third experiment where participants searched for a triangle among different basic shapes.

Figure 4 shows the performance of each participant in Experiments 1 and 2. It illustrates the number of target hits by each participant for noninverted triangles (▲) and inverted triangles (▼) in the cases of moving downward and upward. It visually shows that the performance tends to be higher in the case that the pointing and moving directions are identical. Figure 5 visualizes the statistical analyses in Experiments 1 and 2. It shows the distributions and 95% CIs of the evaluation scores. In all the cases, zero is not within the CIs. It indicates that the null hypotheses in the discussion for Experiments 1 and 2 are rejected even in the two-sided t tests.

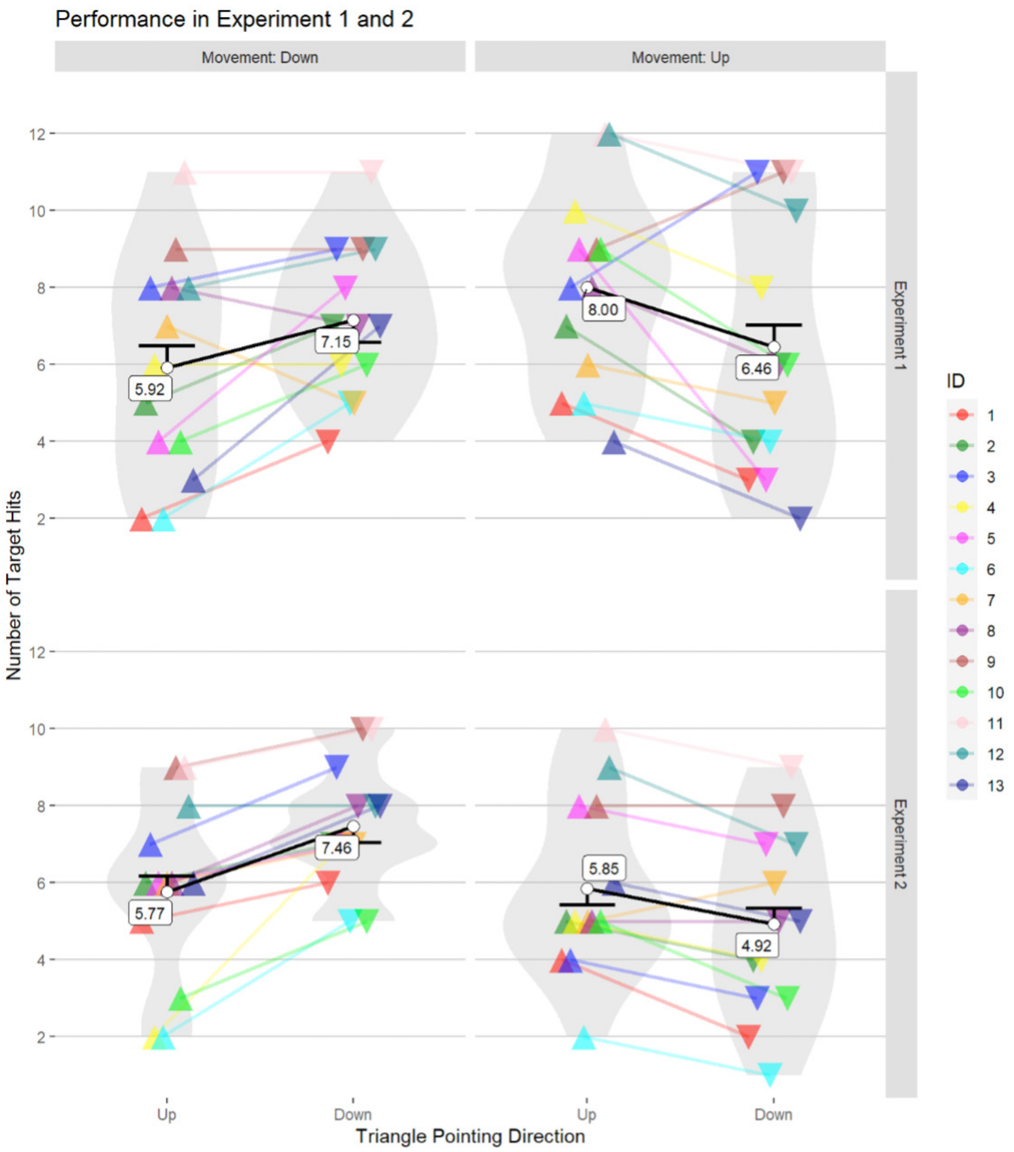


Figure 4: The performances of each participant in Experiments 1 and 2

Both experiments showed that participants could click on more triangles when the triangles moved in the same direction as their pointing direction. This performance advantage might be due to the automatic capture of visual attention by shapes with compatible movements. To test a potential capture of attention, we conducted Experiment 3.

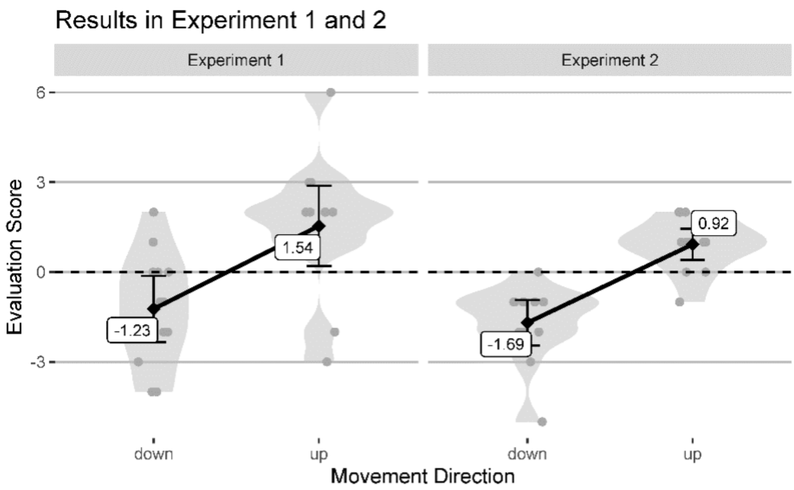


Figure 5: The visualization of the statistical analyses in Experiments 1 and 2. Positive values indicate a performance advantage for noninverted triangles (▲). The error bars are 95% CIs.

4. Experiment 3

In Experiment 3, the target triangle was presented within a horizontal arrangement of five additional distractor shapes. The participants had to find and click on the target triangle as fast as possible. If triangles with compatible movements facilitate attentional capture, such triangles should be found and clicked faster than incompatible moving triangles among the distractors that move simultaneously with the triangle.

4.1 Methods

The participants and testing conditions were the same as in the previous experiments. Experiment 3 was performed consecutively after Experiments 1 and 2.

4.1.1 Design and procedure

In Experiment 3, six basic shapes (isosceles triangles pointing up, down, left, and right, circle, and square) were arranged in a row horizontally on a display area of 8 × 8 cm, as shown in Figure 6. The whole row moved downward or upward while maintaining the horizontal arrangement. The row of shapes moved from top to bottom with a speed of 7 mm/sec, and the participants had to click the noninverted triangle (▲) as soon as possible after the row of shapes appeared on the screen. The trial was repeated five times by randomly changing the order of the shapes. After that, the participants had to click on the inverted triangle (▼) in the same arrangement made of the same five shapes. Following these first ten trials, where the row moves downward, the participants completed the same set of ten trials but with upward movement.

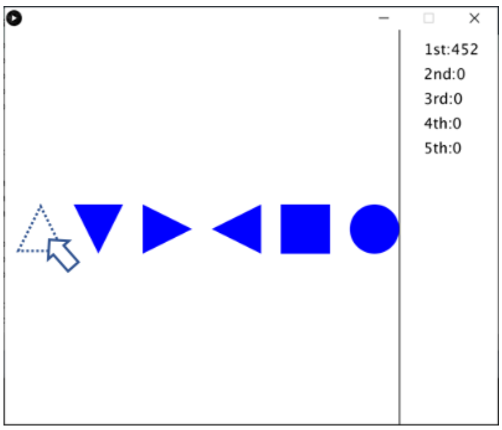


Figure 6: Procedure in Experiment 3. The shapes are horizontally aligned and moving vertically simultaneously. The score is recorded for each of five trials.

4.1.2 Data analysis

We measured performance as (10 times) the vertical distance in millimeters between the shape and the window edge the shape is moving toward (bottom in case of downward movement, top in case of upward movement) at the time of clicking the target shape. Thus, the bigger the number was, the earlier the target shape was clicked and the better the performance was, as shown in Figure 7. If a triangle was not clicked before it reached the window edge, the performance in this trial was recorded as zero. This happened in 17 (6.54%) of all trials, but never more than two times within the five trials of one condition. As in the previous experiments, the evaluation score was then calculated as the average score for noninverted triangles (▲) minus the average score of the inverted triangles (▼). Thus, positive scores indicate better performance for clicking on the noninverted triangle (▲) compared to the inverted triangles (▼) and vice versa for negative scores.

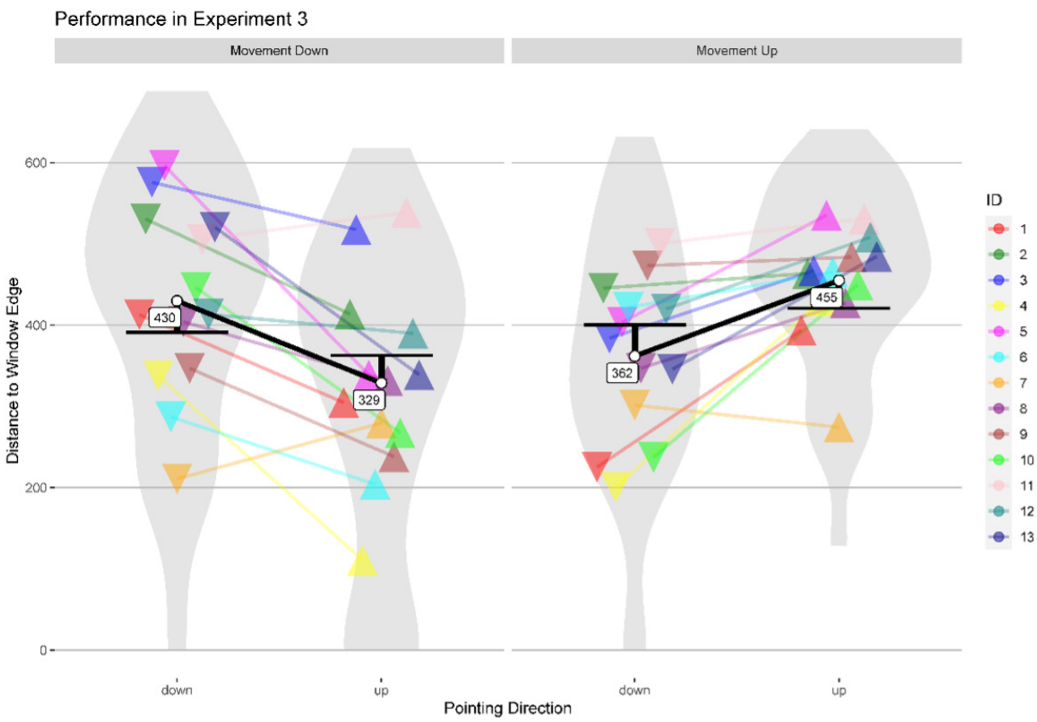


Figure 7: Visualization of the results in Experiments 3. Greater distance indicates better performance. The error bars are comparison intervals that do not overlap if a difference is significant. The gray area shows the distribution of the raw data, including the trials with zero distance (where no response was recorded).

4.2 Results

When the shapes moved downward, the average score was −101.108 [−∞, −53.92], $SD = 95.45$, $d = -0.99$ [−1.73, −0.36], indicating a performance advantage for the inverted triangle (▼). The t test similar to Experiments 1 and 2 was conducted, and the alternative hypothesis, “the score is smaller than zero,” was accepted at $t(12) = -3.82$, $p = .002$. The average score was +93.046 [53.77, ∞], $SD = 79.45$, $d = 1.10$ [0.44, 1.87], when the objects moved upward. The similar test was conducted, and the alternative hypothesis, “the score is larger than zero,” was accepted at $t(12) = 4.22$, $p = .0006$.

4.3 Discussion

In Experiment 3, participants searched for and had to click on an inverted or noninverted triangle that was presented within a horizontal arrangement of six different shapes (one target shape and five distractor shapes). As in the previous experiments, these results indicate that it is faster to respond when the pointing directions of the triangle and the movement direction coincide. Furthermore, the results of Experiment 3 suggest that this compatibility effect facilitates the processing among different target shapes.

5. General Discussion

We conducted three experiments to investigate how the movement and pointing direction of isosceles triangles interact with the performance of searching for and clicking on these shapes. The results consistently showed that performance was better when the pointing and movement direction were the same (i.e., an inverted triangle [▼] moving downward or a noninverted triangle moving upward), compared to cases where these directions were incompatible. These results might indicate that participants quickly derived the intrinsic pointing direction of isosceles triangles and this pointing direction guided visual attention when compatible or incompatible with the shapes' movement direction (Sigurdardottir et al., 2014). Shapes with compatible intrinsic pointing direction and movement direction might automatically capture visual attention, and thus, performance is increased for such targets.

However, there is another explanation based on a type of stimulus-response (S-R) compatibility (Simon and Wolf, 1963; Richez et al., 2016). Stimulus-response compatibility is the effect that responses to stimuli are faster and more accurate when the properties of the stimulus and response are compatible than when they are not (Richez et al., 2016; Simon & Wolf, 1963). For example, when stimuli are presented on the left or right side and responses also correspond to either one of those sides, responses are faster and more accurate if the necessary response to stimuli on the left side is also the left-sided response (S-R compatible) than to the opposite-sided response (S-R incompatible), as illustrated in Figure 8. This so-called Simon effect occurs not only in the visual but also in the auditory modality (Simon & Rudell, 1967), and not only regarding spatial direction but also in time durations (Kunde & Stöcker, 2002). However, it seems that the response has to have a spatial aspect since Ansorge & Wühr (2004) found as Simon effect for a spatial choice-reaction task but not for a go/no-go task.

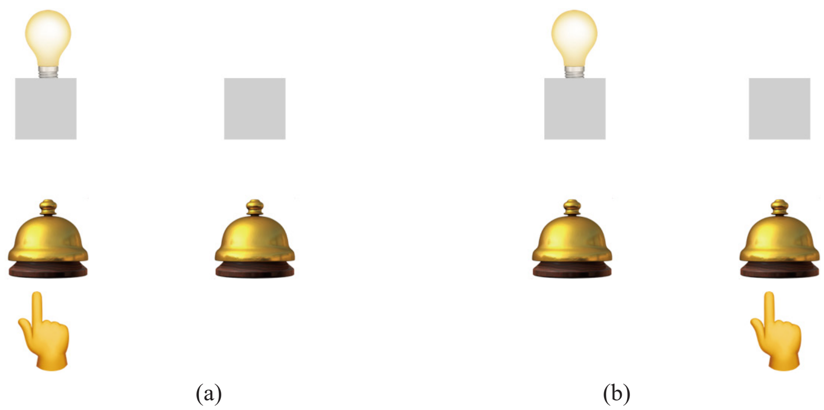


Figure 8: Illustration of stimulus-response compatibility. The participant should ring the left or right bell when one of the lights turns on. (a) It is easier to respond when both the stimulus (light) and response (bell) are on the same side. (b) The response is slower than (a) when the stimulus and the bell are on different sides.

In our experiments, the stimulus has arguably an intrinsic pointing direction and a movement direction, but the participants' responses do not have any spatial-directional aspect. However, in order to catch the moving triangles with the mouse cursor to click on them, the mouse cursor (and likely the eye movements and covert attention as well) might follow the direction of the movement. Thus, there is a spatial-directional aspect in the required response that allows for a compatibility effect with the moving shapes that might not occur during a go/no go task with static stimuli. Thus, we cannot finally conclude whether the results we found are to due attentional capture by shapes moving in compatible directions or due to S-R compatibility. Nevertheless, shape-direction compatible movement is a potential shape or object feature that could guide visual attention (Grüner et al., 2021; Wolfe & Horowitz, 2004), and the influence of the relation between stimuli and responses on performance is highly relevant in many real-world scenarios (e.g. driving a car) and may be similar in applications of VR environments.

Additionally, our results provide insights into how users perceive and interact with moving objects. Improved performance for congruently moving objects can be used as an objective measure of positive affective experience regarding such objects. Better performance indicates facilitated processing, resulting in an easier task and positive internal and external feedback when interacting with congruently moving objects (e.g., Winkielman & Cacioppo, 2001). Furthermore, such an objective measure provides an important complement to subjective methods like questionnaires and interviews to measure Kansei (Schütte et al., 2024). The interaction between users and objects is a central part of affective engineering in analog (e.g., Kittidecha et al., 2016) and digital products (e.g., Furumoto & Zhang, 2023).

The participants are the same throughout the Experiments 1-3. Although it was approved that the respondents had the same ability to play this kind of video game for each experiment, the number and the variety of respondents were limited. It can be a future extension of our research with more respondents of a large variety.

6. Conclusions

The experimental results show that in all conditions of Experiments 1, 2, and 3, responses are significantly easier to click on moving triangles when the pointing directions of the triangle and its movement direction coincide. This effect might be due to stimulus-response compatibility or attentional capture of shapes moving in their pointing direction. In either case, the intrinsic pointing direction (if one exists) and the movement direction of shapes influence performance and should be taken into account when designing using moving objects or interfaces in VR environments. Future studies could and should extend the results to more stimuli, as we assume attention and S-R compatibility are basic principles of human information processing that are not limited to specific stimuli. In future studies, there should also be a similar task with moving shapes but one condition with a movement-related response and one condition with a response not related to any movement, for example, a detection task where participants have to press a button if a specific target is present or not.

Ethics Statement

The studies involving human participants were reviewed and approved by the Kansai University Institutional Review Board on Research Ethics, No. 2019-4.

Author Contributions

AA: conceptualization, statistical analysis, and writing the manuscript. HM: experiments. LL: supervision about S-R compatibility and virtual reality. CMA: reviewing and editing the manuscript. MG: supervision from the viewpoint of a psychologist. All authors contributed to the manuscript revision, read, and approved the submitted version.

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Conflict of Interest

The authors declare that they have no conflict of interest.

Notes

1. Score relative to the *SD*, corrected with the factor suggested by Hedges (1981)

References

Ansorge, U., & Wühr, P. (2004). A response-discrimination account of the Simon effect. *Journal of Experimental Psychology: Human Perception and Performance*, *30*(2), 365–377. https://doi.org/10.1037/0096-1523.30.2.365

Attneave, F. (1968). Triangles as ambiguous figures. *The American Journal of Psychology*, *81*(3), 447–453. https://doi.org/10.2307/1420645

Barnett-Cowan, M., Fleming, R. W., Singh, M., & Bülthoff, H. H. (2011). Perceived object stability depends on multisensory estimates of gravity. *PLoS ONE*, *6*(4), Article e19289. https://doi.org/10.1371/journal.pone.0019289

Cholewiak, S. A., Fleming, R. W., & Singh, M. (2013). Visual perception of the physical stability of asymmetric three-dimensional objects. *Journal of Vision*, *13*(4), Article 12. https://doi.org/10.1167/13.4.12

Clément, G., & Bukley, A. (2008). Mach's square-or-diamond phenomenon in microgravity during parabolic flight.

Neuroscience Letters, *447*(2–3), 179–182. https://doi.org/10.1016/j.neulet.2008.10.012
Firestone, C., & Keil, F. C. (2016). Seeing the tipping point: Balance perception and visual shape. *Journal of Experimental Psychology: General*, *145*(7), 872–881. https://doi.org/10.1037/xge0000151
Furumoto, N., & Zhang, J. (2023). The influence of motion factors on perception of motion in VR spaces. *International Journal of Affective Engineering*, *22*(2), 167–176. https://doi.org/10.5057/ijae.IJAE-D-21-00028
Grüner, M., Goller, F., & Ansorge, U. (2021). Simple shapes guide visual attention based on their global outline or global orientation contingent on search goals. *Journal of Experimental Psychology: Human Perception and Performance*, *47*(11), 1493–1515. https://doi.org/10.1037/xhp0000955
Haddad, L., Wamain, Y., & Kalénine, S. (2024). Stimulus–response compatibility effects during object semantic categorisation: Evocation of grasp affordances or abstract coding of object size? *Quarterly Journal of Experimental Psychology* *77*(1), 29–41. https://doi.org/10.1177/17470218231161310
Hafri, A., & Firestone, C. (2021). The perception of relations. *Trends in Cognitive Sciences*, *25*(6), 475–492. https://doi.org/10.1016/j.tics.2021.01.006
Hedges, L. V. (1981). Distribution theory for Glass's estimator of effect size and related estimators. *Journal of Educational Statistics*, *6*(2), 107–128. https://doi.org/10.2307/1164588
Hulleman, J., & Humphreys, G. W. (2004). Is there an assignment of top and bottom during symmetry perception? *Perception*, *33*(5), 615–620. https://doi.org/10.1068/p5092
Kittidecha, C., Marasinghe, A. C., & Yamada, K. (2016). Application of affective engineering and fuzzy analytical hierarchy process in thai ceramic manufacturing. *International Journal of Affective Engineering*, *15*(3), 325–334. https://doi.org/10.5057/ijae.IJAE-D-15-00022
Kunde, W., & Stöcker, C. (2002). A Simon effect for stimulus-response duration. *The Quarterly Journal of Experimental Psychology Section A*, *55*(2), 581–592. https://doi.org/10.1080/02724980143000433
Lupo, J., & Barnett-Cowan, M. (2015). Perceived object stability depends on shape and material properties. *Vision Research*, *109*, 158–165. https://doi.org/10.1016/j.visres.2014.11.004
Palmer, S. E. (1980). What makes triangles point: Local and global effects in configurations of ambiguous triangles. *Cognitive Psychology*, *12*(3), 285–305. https://doi.org/10.1016/0010-0285(80)90012-2
Richez, A., Olivier, G., & Coello, Y. (2016). Stimulus-response compatibility effect in the near-far dimension: A developmental study. *Frontiers in Psychology*, *7*, Article 1169. https://doi.org/10.3389/fpsyg.2016.01169
Schütte, S., Lokman, A. M., Marco-Almagro, L., Ishihara, S., Yanagisawa, H., Yamanaka, T., Valverde, N., & Coleman, S. (2024). Kansei for the digital era. *International Journal of Affective Engineering*, *23*(1), 1–18. https://doi.org/10.5057/ijae.IJAE-D-23-00003
Shi, J., Wu, C., Zheng, H., Zheng, W., Zhang, X., Lu, P., & Chai, C. (2023). Toward hazard or action? Effects of directional vibrotactile takeover requests on takeover performance in automated driving. *International Journal of Human-Computer Interaction, 39*(19), 3786–3801. https://doi.org/10.1080/10447318.2022.2105479
Sigurdardottir, H. M., Michalak, S. M., & Sheinberg, D. L. (2014). Shape beyond recognition: Form-derived directionality and its effects on visual attention and motion perception. *Journal of Experimental Psychology: General*, *143*(1), 434–454. https://doi.org/10.1037/a0032353
Simon, J. R., & Rudell, A. P. (1967). Auditory S-R compatibility: The effect of an irrelevant cue on information processing. *Journal of Applied Psychology*, *51*(3), 300–304. https://doi.org/10.1037/h0020586
Simon, J. R., & Wolf, J. D. (1963). Choice reaction time as a function of angular stimulus-response correspondence and age. *Ergonomics*, *6*(1), 99–105. https://doi.org/10.1080/00140136308930679
Winkielman, P., & Cacioppo, J. T. (2001). Mind at ease puts a smile on the face: Psychophysiological evidence that processing facilitation elicits positive affect. *Journal of Personality and Social Psychology*, *81*(6), 989–1000. https://doi.org/10.1037/0022-3514.81.6.989
Wolfe, J. M., & Horowitz, T. S. (2004). What attributes guide the deployment of visual attention and how do they do it? *Nature Reviews Neuroscience*, *5*(6), 495–501. https://doi.org/10.1038/nrn1411
Yang, Y.-H., & Wolfe, J. M. (2020). Is apparent instability a guiding feature in visual search? *Visual Cognition*, *28*(3), 218–238. https://doi.org/10.1080/13506285.2020.1779892

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