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*Research Article*

# The Role of Conscious Control Propensity in Determining the Effects of Attentional Foci instructions

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## Abstract

**Background:** In this research, we investigated the role of conscious control propensity in determining the effects of attentional foci on performance and learning of basketball accuracy pass in children (10-12 years old).

**Materials and Methods:** To determine the children's conscious control propensity, the Movement Specific Reinvestment Scale was used. Seventy-two children in two high and low conscious control groups that each group divided to three sub-groups (internal, external, and control) entered the acquisition and transfer and retention tests in the basketball accuracy pass task.

**Results:** The results showed that during the acquisition period, low and high conscious control propensity did not have any effect. Though there was a significant interaction between conscious control propensity and attentional foci in transfer and retention tests, but the main effects were not significant.

**Conclusion:** Based on these results, children's motor learning is more effective when the instructions for attentional foci suited their natural tendencies.

**Keywords:**
Conscious control propensity, attentional foci, performance, motor learning, basketball accuracy pass.

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## 1. Introduction

The previous research drew a distinction between instructions that had internal attentional focus and those used external focus. When the instructions emphasize on the target or results of the movement, it has attentional focus. On the other hand, When the instructions highlight the movement itself, they stress on the external attentional focus (1). The usefulness of focus of attention depends on the relative importance that it gives to the conscious control (2). It is possible to study conscious control through verbal instruction (3).

Considering verbal instructions and the Constrained Action Hypothesis, attention to the results is better than focus on the movement (4), because the external attentional focus, that is target-oriented, increases the automaticity of the movement (5), therefore verbal instructions related to external attentional focus may be more useful than instructions that focus on internal attentional focus (Tse & van Ginneken, 2017). Moreover, the external attentional focus instruction on supra-postural task, compared with the internal one, has led to better postural control (6). The usefulness of external attentional focus in tasks that take time to perform is established as well (4).

Contradictory, the internal attentional focus, that turns the attention to the movement itself, decreases the automaticity and prevent learning to happen effectively (Beilock, 2010). For instance, Rhea, Diekfuss, Fairbrother, and Raisbeck (7) advocated the idea that external attentional foci increased balance movement in both children and adults. However, in skills whose harmonious structures are not yet formed, internal attentional focus is more profitable.

For example, in chip kick learning with non-preferred leg, internal attentional focus was more beneficial (8). Similarly, it has been reported that internal focus of attention enhanced the baseball pitchers' performances (van der Graaff, Hoozemans, Pasteuning, Veeger& Beek, 2018).

For adults, literature supported the advantages of external attentional focus; however, studies have had different results concerning children (Tse & van Ginneken, 2017). The findings suggest that the role of attentional foci in children's motor function are complicated (9).

There are reasons behind this complexity. First of all, compared to adults, children mental faculties are not fully developed (10). They also have a smaller amount of motor automaticity (11).

Next, during the adoption of attentional focus, cognitive styles of individuals should also be taken into account. For example, individuals with a field-independent cognitive style have better performance in situations that they adopt an external attentional focus than an internal one, and those with a field-dependent cognitive style have better performances with an internal attentional focus than an external one (12). Besides cognitive styles, other personality factors may have effect on the usefulness of instructions for attentional foci. One of these personality factors is the conscious control propensity, which specifies the desire of individuals to use explicit and verbal knowledge to control their movement that can be measured using the Movement Specific Reinvestment Scale. This scale is comprised of two factors: Movement Self-Consciousness (MS-C) and Conscious Motor Processing (13).

These factors provide another way to study verbal instructions through measuring conscious control propensity. This propensity modifies the effects of attentional focus in adults (3).

It seems that children increase their conscious control propensity in two contexts. First, when their level of their movement automaticity is low, it, probably, makes them rely on an alternative strategy that is the internal attentional focus. Second, when they have wider cognitive resources that make the internal attentional focus works well. On the contrary, high levels of automaticity and low levels of cognitive resources may lead to low levels of conscious control propensity in children (14).

In the motor learning field of study, when instructions for attentional foci are consistent with the child's conscious control propensity, it is more effective. There may be no significant effect during the initial training (acquisition) period. However, during the transfer and retention tests, children with a high level of consciousness perform better with the internal attentional focus, and children with a low level of consciousness are better in internal attentional focus tasks (3).

In summary, it seems that determining the role of conscious control propensity in the internal and external attentional foci in motor learning is necessary. This matter is more conspicuous regarding children motor behavior, because as mentioned before, research in this area reported different results. One reason is methodological issue (4).

Therefore, in this study we adapted the same instruments that were used by van Ginneken et al., 2017 however we replace the darts task in their study with basketball accuracy pass tasks to see whether the results would be similar or different.

To the best of our knowledge, except van Ginneken et al, no study has been conducted to investigate the effect of conscious control propensity on instructions for attentional foci, especially on Iranian children. The results of the current study can be used in schools, gymnasiums, clinics, etc.

In this study, we will answer the following questions:

1. Are children with a high level of conscious control propensity can learn the best practice of basketball accuracy pass in the context of the internal attentional focus? And
2. Do children with low level of conscious control propensity adopt an internal attentional focus?

It is expected that children with a high level of conscious control propensity, do this task better when they adopt the internal attentional focus than when they adopt the external attentional focus, and children with lower level of conscious control propensity tend to do better in the context of the external attentional focus.

## 2. Materials and Methods

### Participants

Based on Krejcie & Morgan (1970), 173 male students aged 10 to 12, with an average age of 11.3 years and standard deviation of 0.8 were selected from Ardakan primary schools in the academic year of 2018-2019. The participants had no experience of basketball accuracy pass. In addition, they were healthy boys without any developmental disorders.

From the elementary schools of the city (17 schools) seven schools were selected randomly, then a sample of 8 to 10 people, who met the conditions of inclusion in the study, were selected randomly from each school to complete the Movement Specific Reinvestment Scale. Before completing the scale written informed consent forms had been completed by students' parents. In addition, all the procedures of the current research study were approved by the Research Ethics Committee of Sport Science Research Institute of Iran. After data extraction, 72 subjects (36 children with the lowest scores and 36 children with the highest scores) were ordered in two groups of low and high conscious control propensity. Based on the scores, 12 groups of three were formed. In other words, the three who had the lowest scores on a scale went into the same group, the next three, who had the next three scores, were grouped in another group and so on. Within each of these three groups, one person was randomly assigned into the internal attentional focus group, the other in the external attentional focus group, and the third in the control group. In this way, they were randomly divided into three groups of 12 .

### Instruments

Movement specific reinvestment scale

Conscious control propensity was measured using a 10-point and a 6-point Liker- type scale with the score range of 10-60. Thus, the minimum score was 10 and the maximum was 60. The scale is a standardized scale, with the acceptable quality criteria for its validity and reliability (13). In addition, the scale's psychometric properties on adult athletes aged between 18 to 35 were confirmed (15). Its content validity of the Persian version was confirmed by five physical education experts. The reliability of the scale was also estimated by its administration to 43 children, with a Cronbach's alpha of 0.81 in the first administration and 0.83 in re-administration, which indicated a high degree of internal consistency of the scale. In addition, the Cronbach's alpha reliability estimates for sub-scales (factors), namely conscious control processing and motor self-awareness, were 0.66 and 0.69 respectively, which were acceptable.

Test of basketball accuracy pass

In this test, the participant threw the ball from a given distance (600 cm) to concentric circles on the wall (the inner circle is 45 cm, the second is 95 cm, and the third is 145 cm in diameters); in addition, the outer circle's distance from the ground is 90 cm. All passes were performed behind the marked line in three blocks of 10 attempts with three minutes of inter-block rest periods. The scoring for the inner, the middle and the outer circles were three, two and one respectively. If the ball hit the separating line it would be considered as in the circle with higher score. The highest possible score in this test was 30, which was reported as having acceptable validity and reliability (16).

## Procedures

Movement Specific Reinvestment Scale was completed by 173 children aged 10 to 12 years (SD = 0.08 and M = 11.33) to determine their high and low conscious control propensity. Seventy-two children (SD = 0.0815 and M = 11.11) in two groups (36 children with the lowest scores and 36 children with the highest scores on the Movement Specific Reinvestment Scale) were included in the study.

Participants were divided into two groups of high and low conscious control propensity. Then, each group was randomly divided into three groups (n = 12) of internal attentional focus, external attentional focus, and control. The experiment consisted of three sessions: 1) acquisition, 2) transfer, and 3) retention. First, the child acquired a skill (they were taught the performance and the correct technique of basketball accuracy pass); then the internal and external instructions were given to the internal and external attentional focus groups, respectively. The control group received no instruction.

The verbal instructions for attentional foci were given before each block of attempts. The instructions were Persian version of instructions used by Emanuel et al (14). Children in the external attentional focus group concentrated on the central circle (the target) and the internal attentional focus group concentrated on the movement of their throwing arm. Children in the control group did not receive any instructions. At the start of the acquisition period, the participants carried out five basketball accuracy passes to get acquainted with the task. Subsequently, three blocks of 10 attempts with three minutes of inter-block rest were made and the verbal instructions for attentional foci were given before each block of attempts.

The total score of each child's blocks of attempts was measured. At the end of the last block of attempts in acquisition period, the transfer test was performed using a block of 10 attempts while the circles were converted into squares with the same diameters. The retention test was performed after five days after the acquisition and transfer tests. Participants performed three warm up basketball accuracy passes. Next, a block of 10 attempts of basketball accuracy passes were performed from a distance similar to that used during the acquisition period (6 meters). Prior to and during the transfer and retention tests, no instructions for attentional foci were provided.

## Data analysis

After data collection, Shapiro-Wilk and Levene tests were used to determine the normality and homogeneity of variances, respectively. Descriptive statistics of mean and standard deviation, as well as inferential statistics of repeated measure ANOVA were used to determine the differences between groups in the acquisition period, One-way ANOVA was used to determine the differences between groups in the transfer and retention tests, and Fisher Least Significant Difference (LSD) was used for paired comparisons, because there were three means and it was the most powerful post-hoc. Data analysis was performed using SPSS software version 25 at a significant level of $p < 0.05$.

## 3. Results

The normal distribution of data was confirmed by Shapiro-Wilk test (P > 0.05). Using Levene test, homogeneity of error variance in the blocks of attempts in acquisition, transfer, and retention tests in conscious control propensity groups with different attentional foci were confirmed (p > 0.05).

In order to test the equivalence of groups the participants' performances in groups were examined as the baseline performance. As table 1 indicates the result of two-way ANOVA test (F (5,71) = 0.067, p = 0.99) did not show any statistically significant differences between the six groups.

There were not statistically significant differences between the high and low conscious control propensity groups (F (1,71) = 0.28, p = 0.59) and there was not interaction effect between the conscious control propensity and the types of attentional foci (F (2,71) = 0.022, p = 0.97). Similarly, one-way ANOVA showed that the mean for the instructions groups (internal, external and control group) in high conscious control propensity (F (2.35) = 0.018, p = 0.98) and low conscious control propensity groups (F (2,35) = 0.009, p = 0.99) were the same (Fig. 1) and no significant differences were found between the groups (Fig. 1).

### Acquisition Period

During the acquisition period, the repeated measure ANOVA showed that the main effect of the blocks of attempts was significant (F (2,65) = 97.81, p =0.001, ,ηp2= 0. 72). Therefore, it can be said that there is a significant difference between the mean scores of participants' accuracy basketball pass in different the block of attempts, and they have progressed in basketball accuracy pass (the purpose of the current study is not to address the differences). However, in the results of repeated measures ANOVA, no significant difference was found between the high and low conscious control propensity groups (F (1,66) = 0.03, p = 0.86, ηp2=0) and between groups with different instructions for attentional foci (F (2,66) = 0.03, p = 0.09, ηp2= 0.02). In addition, the interaction effect between conscious control groups and attentional foci was not significant (F (2,66) = 0.01, p = 0.99, ηp2= 0) (Fig. 1).

**Table 1. Mean scores and standard deviation of participants' accuracy basketball pass in acquisition period and transfer and retention tests.**

| conscious control propensity groups | instructions for attentional foci | Acquisition Period | | | | | | Tests | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | First block of attempt | | Second block of attempt | | Third block of attempt | | Transfer | | Retention | |
| | | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| high | internal | 7.25 | 3.91 | 8.00 | 4.18 | 9.42 | 4.79 | 13.17 | 5.57 | 12.25 | 4.99 |
| | external | 7.58 | 4.81 | 8.50 | 4.98 | 9.75 | 4.53 | 8.00 | 3.88 | 7.33 | 3.70 |
| | control | 7.42 | 4.06 | 8.17 | 4.71 | 9.92 | 4.91 | 8.33 | 4.79 | 7.58 | 4.32 |
| low | internal | 8.00 | 4.45 | 8.58 | 4.66 | 8.92 | 4.60 | 8.83 | 4.02 | 8.25 | 4.18 |
| | external | 7.83 | 3.83 | 8.50 | 4.52 | 9.58 | 4.87 | 13.33 | 4.98 | 13.08 | 5.09 |
| | control | 8.08 | 5.37 | 8.83 | 5.54 | 9.42 | 5.37 | 9.17 | 4.84 | 8.33 | 4.46 |

## Transfer Test

To examine the effects of independent variables as well as their interaction effects on the dependent variable in the transition test, one-way ANOVA was conducted. The normality of distribution (p =0.12) and equality of variances (p = 0.59) were assumed.

As Table 2 shows, the results of one-way ANOVA indicated that the effect of the whole model, i.e. the interaction effect of conscious control propensity and the types of attentional focus was significant. The main effect of conscious control propensity and attentional foci was not significant.

Considering the significance of the interaction effect of conscious control propensity and the types of attentional focus, the difference between the mean scores of high and low conscious control propensity groups was examined. There were a statistically significant differences in high ($F(2,36) = 4.36$, $p = 0.02$, $\eta p2 = 0.21$), as well as low conscious control propensity groups ($F(2,36) = 3.52$, $p = 0.04$, $\eta p2 = 0.18$) (Fig. 1).

**Table 2. Results of one-way ANOVA on effects of conscious control propensity and attentional foci on learning in transfer test**

| Source | Type III Sum of Squares | Df | Mean Square | F | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|---|
| conscious control propensity groups | 6.722 | 1 | 6.722 | .302 | .584 | .005 |
| Attentional foci groups | 70.778 | 2 | 35.389 | 1.591 | .211 | .046 |
| conscious control propensity * Attentional focus | 280.778 | 2 | 140.389 | 6.310 | .003 | .161 |
| Error | 1468.333 | 66 | 22.247 | | | |

In order to conduct multiple comparisons between the mean scores of children's basketball accuracy passes in different types of instructions for attentional foci in high and low conscious control propensity groups, the Fisher Least Significant Difference (LSD) was used. In children with high conscious control propensity, the difference between means for instructions in the internal and external attentional focus groups (p = 0.013) and internal with control groups (p = 0.019) were significant. However, the difference between external attentional focus and control groups (p = 0.08) was not significant . In children with low conscious control propensity, the difference between the internal and external attentional focus groups (p = 0.023) as well as between external attentional focus and control groups (p =0.08) were significant. However, the difference between external attentional focus and control groups (p = 0.86) was not statistically significant (Table 1).

## Retention Test

To examine the effect of the variables as well as their interaction effects on the dependent variable in the retention test, one-way ANOVA was conducted. The assumptions of normality of data (p = 0.14) and the equality of variances (p = 0.92) have been met. the result of one-way ANOVA in Table 3 shows that the effect of the whole model, i.e. the interaction effect of conscious control propensity and the types of instructions for attentional foci was significant. The main effect of conscious control propensity groups and different types of instructions for attentional foci were not significant (Figure 1). Considering the statistically significant effect of the interaction between conscious control propensity groups and the types of attentional foci, the difference in mean scores for instructions for attentional foci in high and low conscious control propensity groups were examined. Statistically significant differences in the high (F (2,36) = 4.8, p = 0.015, ηp2 = 0.23) as wells as conscious control propensity groups (F (2,36) = 4.36, p = 0.02, ηp2 = 0.21) were found.

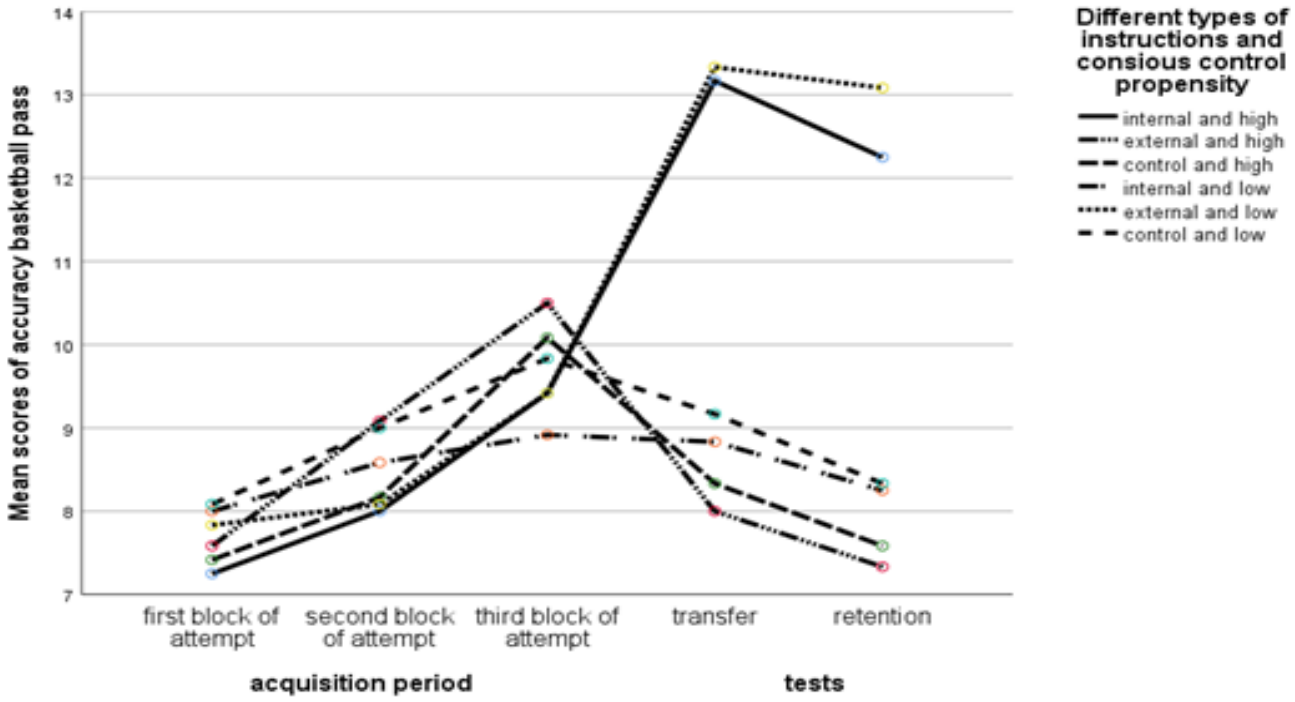
**Table 3. results of one-way ANOVA on effects of conscious control propensity and attentional foci on learning in retention test**

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|---|
| **conscious control propensity groups** | 12.500 | 1 | 12.500 | .622 | .433 | .009 |
| **Attentional foci groups** | 82.528 | 2 | 41.264 | 2.054 | .136 | .059 |
| **conscious control propensity * Attentional focus** | 285.250 | 2 | 142.625 | 7.101 | .002 | .177 |
| **Error** | 1325.667 | 66 | 20.086 | | | |

In order to conduct multiple comparisons between the mean scores of children's basketball accuracy passes in different types of instructions for attentional foci in high and low conscious control propensity groups, the Fisher Least Significant Difference (LSD) was used. In children with high conscious control propensity, the difference between means for instructions in the internal and external attentional focus groups (p = 0.009) and internal with control groups (p = 0.013) were significant .

However, the difference between external attentional focus and control groups (p = 0.89) was not significant. In children with low conscious control propensity, the difference between the internal and external attentional focus groups (p = 0.015) as well as between external attentional focus and control groups (p = 0.016) were significant. However, the difference between external attentional focus and control groups (p = 0.96) was not statistically significant (Table 1).

**Figure 1. Interaction plots for conscious control propensity and types of attentional focus instructions in acquisition period and transfer and retention tests**



## 4. Discussion

In this research, we investigated the role of conscious control propensity in determining the effect of attentional foci on performance and learning of basketball accuracy pass in children. To determine the conscious control propensity in children, the Movement Specific Reinvestment Scale was used. The selected children were involved in acquisition (training) as well as transfer and retention tests in the basketball accuracy pass task in two groups of low and high conscious control propensity and each group was divided into three subgroups according to the types of instructions for attentional foci that were given to them. During the acquisition period, they were training based on adopted instructions of external and internal attentional foci and control group was training without any instructions.

The results showed that high and low conscious control propensity had no effect during the acquisition period, but there were significant interaction effects between conscious control propensity and the types of instruction of attentional foci in the transfer and retention tests. According to our hypotheses, children with conscious control propensity had the best performance when they benefited from internal attentional during the acquisition period. Children who had low conscious control propensity and were influenced by external attentional focus had the best performance and learning. Therefore, the results indicated that children's motor learning is more effective when the instructions for attentional foci are adjusted according to the children's conscious control propensity.

These results are in line with van Ginneken et al [3] Tse and van Ginneken [17] that the effects of external and internal attentional foci on children's motor performance and learning are difficult to deal with comprehensively; these effects depend on the conscious control propensity.

These results are in line with van Ginneken et al [3] Tse and van Ginneken [17] that the effects of external and internal attentional foci on children's motor performance and learning are difficult to deal with comprehensively; these effects depend on the conscious control propensity. Instructions for attentional foci in children are highly successful when they altered in accordance with the learners' conscious control propensity. Accordingly, in the current study no significant effect was found during the initial acquisition (training) period. However, during the transfer and retention tests, children with a high conscious control propensity had a better performance with the internal attentional focus and children with low conscious control propensity were better when had an external attentional focus [17].

## Conclusion

The results could be best explained by the fact that probably on the one hand children with a high conscious control propensity, have a low level of motor automaticity or a high level of cognitive skill, and on the other hand children who have a low level of conscious control propensity enjoy a high level of motor automaticity or have a low level of cognitive skill [17]. According to reports from motor learning studies, there is a positive relationship between the propensity and the learning conditions [18]. Hawk and Shah (2007) suggested that individuals have their own learning styles, if learning style match the learner's activities, their learning and performances will be enhanced. During the adoption of attention centers, cognitive styles of individuals should also be considered [12]. It seems that there is a more important factor among these phenomena and conditions, which in particular are not their intermediary factors of self-knowledge and cognition [17].

In addition, it has been suggested that children have lower levels of motor automaticity. and the advantage of the internal attentional focus is that it can be an acceptable alternative when one lacks sufficient motor automaticity [11,19]. In Skills whose harmonious structure is not yet formed, adopting internal attentional focus is more effective [8]. Children are easily distracted. It is likely that their conscious control propensity distracts their attention and they ignore the instructions. Also, high levels of motor automaticity and low levels of cognitive resources may lead to low levels for conscious control propensity in children [14].

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## Compliance with ethical standards

**Conflict of interest** None declared.

**Ethical approval** the research was conducted with regard to the ethical principles.

**Informed consent** Informed consent was obtained from all participants.

## Author contributions

Conceptualization: M.H., M.A.A., M.P., S.A.H.; Methodology: M.H., M.A.A., M.P., S.A.H.; Software: M.H., M.A.A., M.P., S.A.H.; Validation: M.H., M.A.A., M.P.; Formal analysis: M.H., M.A.A., M.P., S.A.H.; Investigation: M.H., M.P., S.A.H.; Resources: M.H., M.A.A., M.P., S.A.H.; Data curation: M.P., S.A.H.; Writing - original draft: M.A.A., M.P., S.A.H.; Writing - review & editing: M.H., M.A.A., M.P., S.A.H.; Visualization: M.H., M.A.A., S.A.H.; Supervision: M.H., M.A.A., M.P., S.A.H.; Project administration: M.H., M.A.A., M.P., S.A.H.; Funding acquisition: M.P., S.A.H.

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