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Original Article

Physical attractiveness and cooperation in a prisoner's dilemma game

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ABSTRACT

The modulating role of age on the relationship between physical attractiveness and cooperativeness in a prisoner's dilemma game (PDG) was investigated. Previous studies have shown that physical attractiveness is negatively related to cooperative choices among young men but not young women. Following the argument that the negative relationship between physical attractiveness and cooperation is a product of short-term mating strategies among attractive men, we predicted that this relationship is unique to young men and absent among women and older men. We tested this hypothesis with 175 participants (aged 22–69 years). The results showed that physical attractiveness was negatively related to cooperative behavior among young men but not among women or older men. We further observed that the negative relationship between physical attractiveness and cooperation among young men was particularly strong when attractiveness was judged by women.

Physical attractiveness, particularly facial attractiveness, invites favorable responses from other individuals. People tend to perceive that physically attractive individuals possess desirable personal traits, such as intelligence and benevolence. This perception is referred to as the "what is beautiful is good" stereotype, which is an example of the more general halo effect studied in social psychology (Dion et al., 1972). This stereotype has considerable effects on daily life. Hamermesh and Biddle (1994) observed that individuals who were rated "above average" in physical attractiveness earned higher incomes than less attractive individuals. This "beauty premium" is caused by employers' beliefs that good-looking employees perform better than their less attractive counterparts (Mobius & Rosenblat, 2006). Mobius and Rosenblat (2006) observed that employers wrongly expect attractive individuals to perform better and pay them more than less attractive individuals, even when productivity is obviously unrelated to attractiveness. Similarly, individuals judge more attractive women as having desirable traits, such as conscientiousness, compared with their less attractive counterparts (Segal-Caspi et al., 2012). Economic game experiments also indicate that attractive individuals are treated favorably. Participants in a prisoner's dilemma game (PDG) tend to cooperate with participants they find attractive (Mulford et al., 1998). In a public goods game, participants cooperated more with attractive than less attractive partners and expected that attractive partners would be cooperative. Consequently, attractive partners earned more than less attractive partners (Andreoni & Petrie, 2008). Additionally, attractive participants in a trust game were expected to be trustworthy and were therefore trusted by their partners (Wilson & Eckel, 2006). These results consistently indicate that (1) people believe that physically attractive individuals possess desirable traits and (2) attractive individuals are treated more favorably than unattractive individuals (for a meta-analysis, see Langlois et al., 2000).

Is this belief true? Empirical studies of women have revealed that attractiveness does not correlate with desirable inner traits (Segal-Caspi et al., 2012). For men, one laboratory experiment showed that attractiveness functions in the opposite direction than implied by the "what is beautiful is good" stereotype: more physically attractive men were less likely to cooperate during prisoner's dilemma or similar economic games (Takahashi et al., 2006). Zaatari and Trivers (2007) observed a similar pattern in an ultimatum game. The authors observed that the generosity of an offer from male proposers in an ultimatum game was positively correlated with fluctuations in asymmetry (FA; the deviation from bilateral symmetry in the body). Because FA is negatively related to facial attractiveness (Gangestad et al., 1994), this result suggests that the responders' physical attractiveness elicited generous offers from the matched proposer.

1. Physical attractiveness and cooperation

Why is physical attractiveness unrelated or negatively related to the behavioral cooperativeness exhibited in the aforementioned experiments? Fitness-related evolutionary theories explain these results from the logic of mate selection (Takahashi et al., 2006; Waynforth, 2002) or phenotypic quality (Zaatari & Trivers, 2007).

Takahashi et al. (2006) assume that physical attractiveness is an indicator of the good genetic quality of others (cf, Gangestad et al., 1994). Building on this assumption, the authors argue that attractive men would be more likely to pursue short-term mating strategies, whereas less attractive men (who would be less successful in short-

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term mating efforts) would be more likely to pursue an alternative, long-term mating strategy. Physical attractiveness, which is an indicator of good genes, is a high-value asset for short-term mating. Physically attractive men who are desired by women because of their good genes can translate their attractiveness into reproductive success in short-term mating. However, less attractive men who are less successful with such a strategy will turn to an alternative strategy to secure reproductive success in long-term mating efforts. These men must attract long-term mates by accumulating resources that make them desirable long-term mates instead of physical attractiveness. Buss and Schmitt (1993) argued that women who adopt long-term mating strategies seek men who have the ability to invest resources in her and her children on a long-term basis. These women value a partner's economic and social resources (e.g., a good financial prospect). Therefore, cooperation with other members of the community helps men acquire such resources. For example, food sharing is prevalent in hunter–gatherer societies and is critical for survival (Kaplan & Hill, 1985), and sharing is typically conditional on the receiver's willingness to give (Gurven, 2006). The long-term mating strategy adopted by less physically attractive men thus encourages them to cooperate with other individuals to acquire valuable resources to make them desirable long-term mates. The logic that connects physical attractiveness and short- versus long-term mating strategies applies less to women, for whom the advantage of utilizing the short-term strategy is not prominent. A possible advantage of physical attractiveness for women in short-term mating may be in their success at attracting men with good genes, but this potential advantage presumes that men are selective when obtaining short-term mates. However, men who seek short-term mates are generally not selective (Trivers, 1972). Women assume the long-term strategy because they cannot utilize their attractiveness in reproductive success that derives from the quality and not quantity of offspring. Thus, no relationship is predicted between women's physical attractiveness and a long- versus short-term mating strategy, which includes cooperativeness as a component of the long-term strategy.

Zaatari and Trivers (2007) presented an argument similar to ours with some differences emphasized. The authors assumed that symmetrical individuals have a wide range of high quality phenotypes (e.g., resistance to parasites, strength, and mental acuity). Accordingly, more symmetrical and thus more physically attractive and fit men would be less likely to make generous offers in an economic game because their superior phenotypic qualities allow them to gain access to resources by force and without cooperation (e.g., via physical aggression). Waynforth (2002) also proposed a similar argument to ours: asymmetrical men (whose facial attractiveness is low) use mating tactics called "nice guy tactics"—the tactics to display a willingness to help women's reproductive efforts. However, "nice guy tactics" differ from the general cooperative strategy we proposed above as a means to acquire resources. "Nice guy tactics" are directly tied to men's behavior toward women, whereas the general cooperative strategy is a more general means to acquire resources. Although Waynforth could not provide evidence from his questionnaire study to support the presence of a positive relationship between FA and "nice guy tactics," his data did not test the relationship between FA and the general cooperation strategy that extends outside men's relationships with women.

We propose that the cooperativeness strategy, as a means to accumulate resources that may be used to attract women for long-term mating, is a general strategy and not necessarily a means to signal men's willingness to help women in their reproductive efforts. In this respect, our argument is different from the ideas that regard cooperative behavior as a mating signal (Farrelly et al., 2007; Hardy & Van Vugt, 2006; Iredale et al., 2008; Roberts, 1998; Zahavi, 1975). Evolutionary theories, such as the costly signaling theory (Zahavi, 1975) and competitive altruism (Roberts, 1998), predict that individuals will "show off" their willingness to cooperate with potential mates. This feature of our argument, that general cooperativeness is an indirect mating strategy to attract women via resource accumulation, requires a study design in which cooperativeness is measured as a general disposition rather than as a signal to particular partners. This study design, which was adapted in the current study, will effectively eliminate the alternative interpretation that regards cooperativeness as a signaling strategy. Specifically, we used participants' choices in an anonymously played one-shot PDG presented to the participants in an exchange format (e.g., Kiyonari et al., 2000; Yamagishi et al., 2007; see the Method section for details) to measure the level of the participants' general cooperative tendencies.

Despite some differences in the specifics of the mating strategies utilized by more and less attractive men, these evolutionary accounts lead to the identical prediction: more attractive men, particularly young men at the height of their mate choice activities, are less likely to cooperate than their less attractive counterparts are. Previous studies (Takahashi et al., 2006; Zaatari & Trivers, 2007) supported one-half of this prediction—physical attractiveness was negatively related to cooperative tendencies for men but not women. However, the authors' results did not completely address the aforementioned hypothesis between physical attractiveness and cooperation because the negative relationship between the two concepts has only been studied among young men and women. The goal of the present study was to provide full support for the predicted relationship between attractiveness and cooperation. Specifically, we examined whether there was a negative attractiveness–cooperation relationship only for young men and not older men or women regardless of age. Mate selection theory suggests that reproductive competition is more intense among human males than females. Furthermore, male–male competition is considered most intense within age groups in which mating activities are at their peak, as indicated by higher homicide rates among young men than other age–sex groups (Hiraiwa-Hasegawa, 2005; Wilson & Daly, 1985). Furthermore, a preliminary questionnaire study shows the negative correlation between age and short-term mating preference among males, but not females (male: $r=-.18$, $p < .01$, $n = 233$; female: $r=-.10$, n.s., $n = 240$). Older males tend to pursue short-term mating opportunity less than younger males (Shinada et al., 2014). The negative link between age and short-term mating orientation among males suggests that mating activity is more intense among young males than older men or women regardless of age.

2. Methods

2.1. Procedure

2.1.1. Participants

A total of 206 men and women from Sapporo, Japan, 22–69 years old as of February 2009, participated in the study. One hundred and one participants played a one-shot PDG in February and March 2009. The remaining 105 participants played the identical PDG in February 2011. Of the 206 participants who played the PDG, 183 participated in a photography session in October and November 2011. Before playing the PDG, the participants answered a series of questions, including questions about demographic variables such as age, sex, and wealth. The participants' written consent was obtained before their photograph was obtained for research purposes. The participants were asked to remove any adornments (e.g., glasses or accessories) and pose with a neutral expression. Seven participants refused to have their photograph taken or failed to remove their eyeglasses and were excluded from further analyses. We also eliminated one participant's picture because of his inability to understand the PDG payoff structure. Thus, facial photographs of 87 men (age: $M = 45.36$, $SD = 12.96$) and 88 women (age: $M = 45.97$, $SD = 12.45$) were subjected to attractiveness judgments. Each photograph was cropped above the upper forehead and below the chin and edited to form a square. Using the above-described procedures, we obtained facial

photographs and behavioral data from 175 participants in the one-shot PDG. We then asked a group of judges to rate the facial attractiveness of the pictures.

2.1.2. The PDG

The PDG was conducted using an exchange protocol (Yamagishi et al., 2007). The identical incentive structure corresponding with the PDG can be presented to the participants in several formats, such as in a matrix, which is commonly known as the prisoner's dilemma matrix, a game-tree format, or an exchange form, which we used in our study. The exchange format has been used in many other studies (e.g., Kiyonari et al., 2000; Yamagishi et al., 2007). The advantage of the exchange form is that it is intuitively understood by the participants. In the current study, five to eight individuals participated in one session, and the participants were informed that the pairs were formed randomly. When an odd number of individuals participated, one of the participants was paired with two of the other participants. This participant's choice was used to determine the reward for each partner, and the choice of one of the two partners was used to determine the reward for the double paired participant. From the participant's perspective, each participant was paired with another individual and was paid for the choices of both his or her own decision and the matched partner's decision. Each of the two participants was provided an endowment of JPY 2,000 (approximately US$20). Each participant decided how much of the endowment to give to a randomly matched partner. The provided money was then doubled and given to the partner. The participant retained the money that he/she did not give away. The game was symmetrical, such that each of the two participants decided how much to give their partner and then received twice the amount the other participant offered. If both participants provided JPY 2,000 (fully cooperated), each received JPY 4,000. If one participant fully cooperated and provided JPY 2,000, and the other participant offered no money, the one who fully cooperated earned nothing, and the one who completely defected earned JPY 6,000. Therefore, giving less was a dominant choice (i.e., the participant earned more by giving less regardless of the level of giving by the partner). If both participants chose this dominant strategy, each earned JPY 2,000 (mutual defection) instead of JPY 4,000 for mutual cooperation. These outcomes corresponded to the four cells in the standard PD matrix. Instead of choosing cooperation or defection as in the standard matrix form, participants in the exchange form PDG could choose different levels of cooperation. They could choose any value of the JPY 2,000 of the endowment (see Table 1). We used the proportion of money that each participant provided his or her partner as a measure of cooperation. The participants generated their decisions anonymously. Namely, each participant was informed of the matched partner's choice at the end of the experiment but could not identify their partner. Therefore, the participants did not know other individuals' decisions. Additionally, the participants did not see or talk to the other participants. Furthermore, the experimenter who interacted with the participant was not informed of the participant's choice. The experimenter who calculated the outcomes did not face the participants and was not informed about the identity of the participants.

Table 2
The effects of participants' age, sex, and attractiveness (rated by both male and female judges) and their interactions with cooperation level in a regular regression analysis.

	B (SE)	*t*	*p*
Intercept	853.23 (49.08)	17.39	<.0001
Sex (−0.5 = F, 0.5 = M)	85.26 (98.16)	.87	.39
Age	11.19 (3.95)	2.83	<.01
Attractiveness	11.55 (94.71)	.12	.90
Sex × Age	12.10 (7.90)	1.53	.13
Sex × Attractiveness	−6.48 (189.43)	−.03	.97
Age × Attractiveness	7.48 (6.96)	1.07	.28
Sex × Age × Attractiveness	33.17 (13.92)	2.38	.02

2.1.3. Attractiveness judgment

Seventy-three Japanese university students (37 males, age: $M = 19.1$ years; 36 females, age: $M = 20.7$) judged the physical attractiveness of the 175 facial photographs. The judges were not informed about the identity of the photographed individuals or whether they played the PDG. The judges were paid JPY 500. The photographs were presented to the judges on a PC screen in a random sequence. The judges were asked to rate the physical attractiveness of each face on a 7-point scale (1 = unattractive, 7 = attractive). In the following analysis, we used the mean of the male judges' ratings, the mean of the female judges' ratings, and the overall attractiveness ratings as indicators of the participants' physical attractiveness. Thus, the statistical unit of analysis used was the participant (i.e., the photographed individual) and not the judges.

3. Results

3.1. Physical attractiveness

The reliability of the attractiveness ratings was high (Cronbach's $\alpha = .94$ for female judges, $\alpha = .93$ for male judges, $\alpha = .97$ for all judges). The overall mean attractiveness rating of the 175 participants was 3.41 ($SD = .56$) and was distributed from 2.15 to 5.12. The interaction between the participant's and judge's sex was significant ($F(1, 173) = 172.63$, $p < .0001$): female targets were rated as more attractive by female judges ($M = 3.59$, $SD = .63$) than male judges ($M = 3.35$, $SD = .61$). Male targets were rated as more attractive by male judges ($M = 3.46$, $SD = .52$) than female judges ($M = 3.26$, $SD = .50$).

3.2. Cooperation

On average, the participants provided their partners with 43.9% of the endowment of the JPY 2,000 ($M = 877.71$, $SD = 653.39$). The male participants provided more ($M = 931.03$, $SD = 700.88$) than the female participants ($M = 825.00$, $SD = 602.15$), but this difference was not significant ($t(173) = 1.07$, *n.s.*).

Table 1
The incentive structure of the PDG used in the current study expressed as a payoff matrix.

		Participant A's cooperation level (i.e., how much A gives)				
		2000	1900	……..	100	0
Participant B's cooperation level	2000	4000R4000	3800R4100		200R5900	0R6000
	1900	4100R3800	3900R3900		300R5700	100R5800
	.					
	.					
	.					
	100	5900R200	5700R300		2100R2100	1900R2200
	00	6000R0	5800R100		2200R1900	2000R2000

Note. Any combination of two rows and two columns forms a 2 × 2 prisoner's dilemma matrix (although not symmetrical).

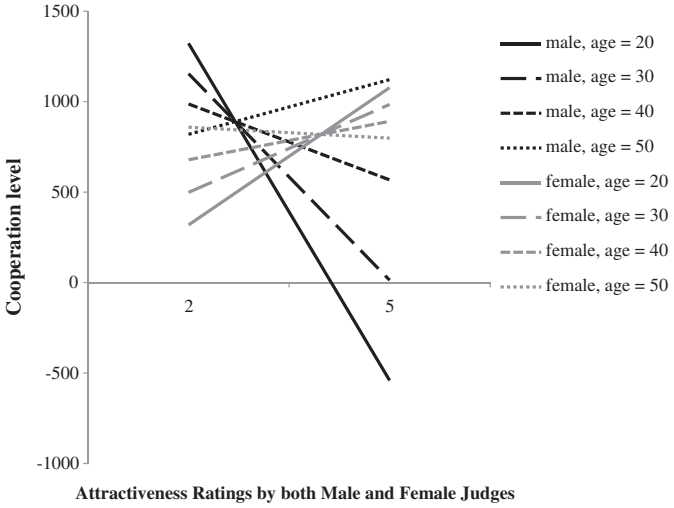

Fig. 1. The relationship between attractiveness rating and the target's cooperation level in the Prisoner's Dilemma Game for each combination of the sex and the age of the target pictures. Each line is not a regression line obtained for a regression analysis for each group of pictures; each line is constructed by combining the predicted scores based on a single regression analysis in which age, sex, and attractiveness rating and their interactions are used to predict the target's cooperation level.

Attractiveness predicts cooperation among young men. Table 2 presents the results of an ordinary least squares regression analysis, in which the cooperation level was predicted by the overall attractiveness, sex, and age of the target picture (converted into a deviation score from the mean), and their interaction terms. Our focus was the three-way interaction between attractiveness, age, and sex. Namely, we predicted that the sex differences in the effect of attractiveness on cooperation (the two-way attractiveness × sex interaction) that Takahashi et al. (2006) observed would be unique to the young age group. The predicted three-way attractiveness × sex × age interaction was significant ($b = 33.17$, $t = 2.38$, $p < .02$). Fig. 1 shows the pattern of this three-way interaction. Fig. 1 shows the predicted regression line, calculated from the coefficients reported in Table 2, for each age combination (20, 30, 40, and 50 years old) and sex. The horizontal axis in Fig. 1 indicates the attractiveness rating that was distributed from 2 to 5, in which 99% of the attractiveness ratings occurred. The effect of attractiveness on cooperation was pronounced among young men, as was predicted. Among young women, attractiveness tended to be positively, although not significantly, related to their cooperation level. Among the older participants, the two-way attractiveness × sex interaction was absent. The absence of a significant two-way attractiveness × sex interaction appears to reflect the absence of this interaction among the older participants. In addition, the main effect of age was significant ($b = 11.19$, $t = 2.83$, $p < .01$), thus indicating that older participants were more cooperative than younger participants. Controlling for the participant's income and sex did not reduce the effect of age on cooperativeness.

From the Fig. 1, it is evident that the differential effect of attractiveness on cooperation between men and women is specific to younger participants. This result replicates previous results that attractive young men are less cooperative than less attractive young men. Furthermore, the result shows that the negative relationship between attractiveness and cooperation was absent in the other age–sex groups. To confirm these conclusions, we conducted an additional regression analysis, in which we used three dummy variables for combinations of age and sex (d1 = 1 for males older than 40 years, d2 = 1 for females 40 years old or younger, and d3 = 1 for older females) and their interactions with attractiveness. The results showed that the effect of attractiveness in the base category (younger men) was significant and negative ($b = -449.67$, $t = 2.01$, $p < .05$). Two of the interaction effects, d1 × attractiveness ($b = 771.89$, $t = 2.72$, $p < .01$) and d2 × attractiveness ($b = 668.93$, $t = 2.41$, $p < .05$), were significant, which indicated that the negative effect of attractiveness was stronger among young men than older men (d1 × attractiveness) and among young men than young women (d2 × attractiveness). The remaining d3 × attractiveness interaction was positive but not significant ($b = 382.03$, $t = 1.38$, $p < .17$).

We further examined whether the sex of the judges modulated the effect of attractiveness we observed for younger men. For this analysis, we focused on younger male participants (40 years old or younger, $N = 29$) who showed a prominent attractiveness–defection relationship (Fig. 1). First, we separately regressed the young male participants' cooperation levels on attractiveness judged by male and female judges. The regression coefficient was $b = -317.89$ (SE = 234.50) when attractiveness was rated by male judges, and the effect was not significant ($t(27) = -1.36$, $p = .19$). However, when attractiveness was rated by female judges, the negative regression coefficient increased to $b = -611.87$ (SE = 283.11), and the effect was significant ($t(27) = -2.16$, $p < .05$). In the second analysis, we regressed cooperation level on the overall attractiveness (mean attractiveness judgment by both male and female judges) and the difference between male and female judges' attractiveness ratings. We used this regression analysis instead of a second regression analysis that regressed cooperation and judgments by male and female judges to avoid the strong multicollinearity problem because of the strong correlation between the two variables ($r = .93$, $p < .0001$). The effect of the overall attractiveness ratings ($b = -798.23$, $SE = 294.18$, $t = -2.71$, $p < .05$) and the difference score between female and male judges' attractiveness ratings were both significant ($b = -1436.49$, $SE = 670.58$, $t = -2.14$, $p < .05$). These results indicated that young men's attractiveness had a more pronounced negative effect on their cooperative tendencies when attractiveness was judged by women compared with men. The results of this additional analysis further support that mate selection accounts for the male-specific negative relationship between attractiveness and cooperativeness and indicates that men's attractiveness toward a potential mate (i.e., women), and not attractiveness to other men, is more important.

4. Discussion

The goal of the current study was to experimentally demonstrate that the previously observed negative relationship between men's, but not women's, physical attractiveness and cooperative tendencies is limited to young age groups who are highly involved in mate selection activities. Explanations for the negative relationship between attractiveness and cooperative tendencies have been offered in previous studies (Takahashi et al., 2006) based on the mate selection theory of evolution (Trivers, 1972) that physical attractiveness can be used to promote reproductive success in short-term mating. For less attractive men whose success with short-term mating is unfavorable, an alternative mating strategy is resource accumulation through cooperation with other individuals (Takahashi et al., 2006). From this standpoint, the negative relationship between cooperation and physical attractiveness among men should be pronounced at the height of mating activity. We tested this hypothesis in a laboratory experiment using participants with a wide age range (22–69 years old). The results supported our hypothesis: less attractive young men cooperated at higher levels in the PDG than their more attractive counterparts. This relationship was not observed among the other age–sex categories (i.e., older men and younger and older women). The design of the experimental game, characterized by the anonymity of the participants' choices and absence of possible future interactions with a partner, effectively eliminated the possibility of an alternative interpretation of the relationship that cooperative choices are signals of the participants' willingness to help the interaction partner. However, this feature of the study design could not eliminate the

possibility of another interpretation proposed by Zaatari and Trivers (2007). The authors argue that the male-specific negative relationship between body symmetry and cooperativeness is related to males' physiological strength, thus allowing them easy access to valuable resources through physical aggression. Although Zaatari and Trivers (2007) did not explicitly state that the negative relationship between physical attractiveness and cooperation would be more pronounced among younger men, the age-specificity of the relationship is implied by their logic. Thus, our result is consistent with both explanations.

In addition to the main results summarized above, we also observed that the young male-specific negative relationship between attractiveness and cooperation was more pronounced when attractiveness was rated by female rather than male judges. This result was consistent with the argument that attractive men have an advantage in short-term mating because the attractiveness judgments by females should be more relevant to successful short-term mating than the judgments by males. However, if the negative relationship between attractiveness and cooperation stems from attractive men's physical strength (Zaatari & Trivers, 2007) rather than their appeal to potential mates, the judge's sex should be irrelevant. We suspect that the current results provide tentative support for the negative relationship between attractiveness and cooperativeness differences in short- versus long-term mating strategies. However, further evidence is necessary to draw firmer conclusions.

This study is the first to examine whether the negative effect of physical attractiveness on cooperative tendencies among men was limited to younger individuals. However, our results must be replicated in studies using different methodologies before drawing definite conclusions. Although a preference for short-term mating is associated with physical attractiveness among men (Perilloux et al., 2012), no study has successfully demonstrated a positive association between the preference for short-term mating and an absence of cooperation. Because of the difficulty in directly assessing the participant's preference for short-term mating, the absence of such evidence is understandable but worth further research efforts. Another limitation of the current study should also be noted. The present study was conducted with a single cultural group (Japanese participants and judges). Although a meta-analysis of attractiveness judgments revealed that individuals largely agree on physical attractiveness within and across cultures (Langlois et al., 2000), females' preferences for males varies across populations depending on ecological conditions, such as parasite load (Little et al., 2007; Penton-Voak et al., 2004). Further research should focus on ecological factors and individual characteristics when investigating the relationship between attractiveness and cooperation.

Supplementary Materials

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.evolhumbehav.2014.06.003.

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