

## REGULAR ARTICLE

# Kangaroo Mother Care, home environment and father involvement in the first year of life: a randomized controlled study

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## Keywords



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## Abstract

**Aims:** This study tested the hypothesis that Kangaroo Mother Care creates a climate in the family, which enhances infants' performance on the developmental quotient scale.

**Setting:** The largest social security hospital in Colombia with a neonatal intensive care unit.

**Subjects:** At 12 months of corrected age, 194 families in the Kangaroo Mother Care group and 144 families in the Traditional Care group were available for analysis.

**Interventions:** Infants were kept 24 h/day in an upright position, in skin-to-skin contact until it was no longer tolerated by the infants. Babies in the Traditional Care were kept in incubators on the Minimal Care Unit until they satisfied the usual discharge criteria.

**Outcome measures:** The Home Observation for Measurement of the Environment (HOME), Father Involvement and Developmental Quotient (Griffiths) scores.

**Results:** 1) Kangaroo mothers created a more stimulating context and a better caregiving environment than mothers in the Traditional Care group; 2) this environment was positively correlated to father involvement and 3) the family environment of male infants was most improved by Kangaroo Mother Care.

**Conclusion:** Kangaroo Mother Care has a positive impact on home environment. The results also suggest, first, that both parents should be involved as direct caregivers in the Kangaroo Mother Care procedure and secondly, that this intervention should be directed more specifically at infants who are more at risk at birth. The Kangaroo Mother Care intervention could be an excellent means to ensure parents' mature involvement in the future of their children.

## INTRODUCTION

Since 1989, the Kangaroo Mother Care method has been developed, enhanced and evaluated by a team from the Kangaroo Foundation in Colombia and is now seen as a major Colombian contribution to decreasing the mortality of low birthweight infants in the world (1–3). As a result of this work, more than 25 developing countries and some developed countries including the United States (4,5), England (6), France (7), Sweden (8), Canada (9) and the Netherlands (10) have introduced skin-to-skin contact in nurseries for premature infants. It is generally hypothesized that this kind of care promotes physiological stability and enhances the parent–child relationship (11). Most of the published studies on skin-to-skin contact have focused on the physiological benefits for the baby, while a few have dealt with the parent's and the child's psychological well-being (11–15).

In a randomized controlled trial conducted in Bogota, Colombia, at 40 weeks of postmenstrual age, we observed a change in the mother's sensitivity and perception of her child attributable to skin-to-skin contact in the kangaroo carrying position. At this point, we suggested that this effect was related to a subjective bonding which might be explained by the 'empowering' nature of the intervention

(15). We also observed that mothers in the Kangaroo Mother Care group had behavioural patterns that were adapted to the child's health status and that they felt more competent than those in the Traditional Care group did if the baby was sick at birth. We explained these results by the fact that the intervention is scheduled in the post-NICU routine care period, which is generally viewed as an obstacle to caring for and touching the baby and severely hampers the normal parent-child interaction process. Kangaroo Mother Care shortens this suboptimal period by allowing the parent to play an active role and become more deeply involved in the care routine.

A short-term consequence of this early parental involvement was observed in a differential Developmental Quotient. Those allocated to the continuous kangaroo position had a higher Quotient than those given traditional care (101.1 vs. 97.4;  $p < 0.02$ ). Moreover, preterm infants who required intensive care and were diagnosed as having doubtful or overtly abnormal neurological development at 6 months had a significantly higher Developmental Quotient score (12.9 points on the Griffiths total scale) in the intervention group as compared with the Traditional Care group (16). On the basis of these results, we suggest that Kangaroo Mother Care creates a climate in the family

whereby parents become progressively more aware of the child and more sensitive in their caregiving, which could explain these positive results with respect to the infant's development at one year.

## OBJECTIVE AND HYPOTHESIS

The main objective of this study was to evaluate the family transformations associated with the Kangaroo Mother Care intervention and the correlates of infant development. The hypothesis is that the social and home environment (as assessed by the HOME test procedure) will be more structured and stimulating in the Kangaroo Mother Care group. Moreover, it is suggested that fathers' involvement will be greater than in the Traditional Care group, which will, in turn, be associated with developmental opportunities favouring infants in the intervention group as opposed to infants in the Traditional Care group. This hypothesis, which is supported by previous studies (17,18), suggests that these environmental variables (home quality and father involvement) will mediate the link between the Kangaroo Mother Care intervention and children's developmental quotient at one year.

## METHOD

### Population and sample

This study is the second part of a randomized, controlled trial conducted in Bogota, Colombia (19) on a cohort of 746 eligible infants weighing less than 2001 grams and born between September 1993 and September 1994 at the Clinica San Pedro Claver. Inclusion and exclusion criteria have been presented in previous papers (19,20). Of the initial group of 746 infants, 30 (4.1%) died between eligibility and 12 months (the mortality rate was similar in both groups) (20), 134 (18%) abandoned the study, 21 (2.8%) mothers did not follow instructions (some did not carry the baby in the Kangaroo group or carried the baby in the Traditional Care group) and eight were lost owing to rehospitalization during the intervention period. The study group was thus reduced to 553 available families: 280 in the Kangaroo Mother Care group and 273 in the Traditional Care group. However, the social worker only had time to visit a reduced number (69% of children in Kangaroo group and 53% of Traditional Care children) of these families before 12 months, (between 9 and 12 months). To maintain coherence in the data collection timing, we retained only the families that had been visited and, of those, only the families whose child had received a cognitive evaluation at 12 months. Thus, 194 Kangaroo Mother Care and 144 Traditional Care children remained in the study. This final group of 338 dyads was compared with the subgroup of 215 non-participating dyads (86 Kangaroo and 129 Traditional Care). No difference was found in the 2 groups  $\times$  2 status (participating vs non-participating) analyses of variance in the sociodemographic backgrounds of the families ( $F(3, 321) = 1.5$ ; NS for parents education and family income) or in the infants' neonatal variables

( $F(3, 332) = 0.19$ ; NS for weight, height and gestational age at birth).

## Kangaroo Mother Care and Traditional Care interventions

Kangaroo Mother Care has three components: the first is the kangaroo position. Once the premature infant has adapted to extrauterine life and is able to breastfeed, he<sup>1</sup> is discharged and positioned on the mother's chest, in an upright position, with direct skin-to-skin contact. It should be stressed that the kangaroo position has the same temperature-regulating properties as an incubator (21–23). The mother and infant may then be released from the hospital regardless of the infant's actual weight or gestational age. The infant is maintained in this position continuously, 24 h a day, until he demonstrates behaviourally that he is ready to leave, usually at around 37–38 weeks of gestational age. Other caregivers (e.g. the father, the grandmother) may alternate with the mother as a kangaroo position provider. The second component is kangaroo nutrition. Although breastfeeding is the prime source of nutrition, infants may also receive preterm formula and vitamin supplements, whenever necessary. The third component is clinical control: infants are monitored on a daily basis until they are gaining at least 20 g per day. Weekly visits are then scheduled until term (40 weeks of gestational age), which constitutes the minimal ambulatory neonatal care as compared to minimal routine inpatient care.

In the traditional care group, infants are kept in incubators until they are able to self-regulate their temperature and are thriving (i.e. show appropriate weight gain). Infants are discharged according to current hospital practice, that is, usually not before their weight is around 1700 g. These infants receive the same outpatient care and follow-up as infants in the Kangaroo group. Thus, the Traditional Care group infants have an inpatient period as well as an at-home period lasting until term. In both groups, mothers were encouraged to breastfeed their infant as early as possible during the inpatient period.

## Outcome variables

The Home Observation for Measurement of the Environment (HOME) (24) is based on proximal environmental variables previously found to be related to developmental outcome (25). A structured interview was administered to parents during a home visit when the infant was 9–12 months old (corrected age). The interview consists of 45 yes/no questions; 18 of the questions can be answered by simple observation during the visit, while the remaining 27 questions require an interview. The original test comprises six subscales. Factor analysis of items in this study failed to replicate the original factor structure, which might be attributable to cultural discrepancies and hence, further factor analytical work was undertaken. Based on analysis of this study group ( $N = 338$ ), five factors were

<sup>1</sup>The masculine pronoun is used for all infants solely to simplify the text.

extracted instead of the six original ones. The first subscale is named 'Stimulating family environment' and includes the provision of materials, the mother's educational stimulation and the presence of other adults, such as the father and friends. The second subscale is named 'Mother's emotional responsiveness'. The father, friends, and members of the extended family visiting each other and collaborating define the third subscale, 'Family openness'. The fourth subscale is named 'Maternal positivity and avoidance of behavioural restriction' and includes the mother's avoidance of restrictions and punishment during the interview. The fifth subscale is 'Equipment availability', including a safe play environment and appropriate materials. This factor structure was replicated on two different segments of the sample (cross-validation) and produced the same basic structure with some minor variations in item loadings. As in the original form, we also constructed a total score representing the quality of the child's environment. We consider this new factor structure to be a valid representation of the home environments in our Bogota sample.

### Cognitive development

The Griffiths Scale of Mental Development (26) was administered at 12 months ( $\pm 2$  weeks), corrected age, to all infants to assess their skills in six areas: locomotor, personal-social, hearing and speech, eye and hand coordination, performance and practical reasoning. In addition, a general developmental quotient was obtained by combining the scores on all subscales and was calculated for the child's age corrected for prematurity. This measure is widely used and its reliability and validity are well established in Colombia (27).

### Father involvement

This score was constructed from one question included in the Mother's Perception of Premature Birth Questionnaire (15), which includes three domains: the mother's perception of support, the mother's feelings and worries, and the mother's sense of competence. This questionnaire was administered five times as part of the follow-up from birth to 12 months (at 41 weeks of gestational age, and at 3, 6, 9 and 12 months of corrected age). The question related to the mother's perception of her husband's support during the first year was used to measure the quality of the husband's support and involvement in the family.

### Control variables

Many control variables were introduced to optimize interpretation of the data, including gestational age at birth, gender, weight, height and head circumference at birth, intrauterine growth diagnosis according to the Lubchenco classification (28), need for intensive care at birth, parity, Apgar score at 1 and 5 min, age, weight, height and head circumference at eligibility, family sociodemographic descriptors, pregnancy and delivery variables. Using the Infanib test (29), we also indexed the neurological risk status at 6 months of corrected age as a

gross estimation of the infant development. The infants were categorized as 'normal' or 'doubtful' following precise Infanib criteria.

### Procedures

All infants were evaluated from birth to 12 months of corrected age by a team of paediatricians, nurses, social workers and psychologists. Between 9 and 12 months, the parents were interviewed at home by a social worker using the HOME inventory and, at 12 months, infants were tested in the clinic using the Griffiths test scales to obtain a developmental quotient. Other measures of socioemotional development were performed but are not reported here. Multivariate and univariate analyses of variance were performed using SPSS 12.0 for Windows.

### RESULTS

Kangaroo Mother Care and Traditional Care groups were similar at birth with respect to sociodemographic criteria and factors related to pregnancy and labour (Tables S1 and S2).

### HOME observations

A series of analyses were first performed with HOME (5 subscales and a total score) as dependant variables and Intervention groups as an independent variable. As the child's gender is recognized as a powerful determinant of many outcome issues (30,31), it was introduced as a moderating variable. Moreover, neurological status, which may seriously affect infant outcomes, was also included as a moderating variable.

Results indicate an Intervention effect on the total HOME score suggesting that, during the first year of an infant's life, Kangaroo families (mean = 0.28) as compared to Traditional Care families (mean = -0.51) provide a more developmentally oriented caregiving environment ( $F(1, 330) = 4.9, p < 0.03$ ) (Table S3). This effect is mainly observed in the neurologically at-risk group of infants (doubtful status) where Kangaroo Mother Care families offer a much more positive environment (mean boys and girls = 0.33) as compared with TC families (mean boys and girls = -1.09) ( $F(1, 330) = 5.2, p < 0.03$ ). Moreover, univariate analyses indicate an interaction effect where the boys in the Intervention group (mean = 0.26) are favoured by a more developmentally oriented family environment as compared with the boys in the Traditional Care subsample (mean = -1.02) ( $F(1, 330) = 7.2, p < 0.01$ ). This between-group effect is most evident for boys who had a doubtful neurological status at 6 months of (corrected) age (means = 0.20 vs -1.97) ( $F(1, 330) = 7.3, p < 0.001$ ), suggesting a protection effect against neurological deficits in those Kangaroo families (Table S3). No such statistical difference was observed in the girls' subsample.

The moderating role of the child's gender and neurological status is again obvious in the HOME sub scores, where significant multivariate Sex by Group interactions ( $F(5, 326) = 5.07, p < 0.000$ ) and Sex by Group by Neurological

Status ( $F(5, 326) = 2.98, p < 0.02$ ) interactions were observed. Univariate analyses indicate that families are more open (Table S3, Open family subscale) in the Intervention group ( $F(1, 330) = 3.9, p < 0.05$ ), namely, in the subgroup of girls ( $F(1, 330) = 9.4, p < 0.01$ ) as opposed to girls in the Traditional Care group. More specifically, the intervention effect was mainly observed in the neurologically doubtful status subgroup of girls (means = 0.17 vs -0.87) ( $F(1, 330) = 9.03, p < 0.01$ ) (Table S3).

The impact of the intervention was also observed in three other HOME subtests favouring the boys ( $F(5, 326) = 3.10, p < 0.01$ ). Mothers of male children in the Kangaroo group are more responsive ( $F(1, 330) = 9.1, p < 0.01$ ), more positive (less punitive) ( $F(1, 330) = 3.5, p < 0.10$ ) and offer a more structured environment including more space and more age-appropriate toys ( $F(1, 330) = 5.3, p < 0.03$ ) when compared with mothers of male Traditional Care children (Table S3). As previously reported for girls, neurological status has a moderating effect, whereby the boys with a transient/doubtful status are protected by a more responsive ( $F(1, 330) = 7.3, p < 0.01$ ) and more positive mother ( $F(1, 330) = 3.5, p < 0.10$ ) in a more structured family ( $F(1, 330) = 10.7, p < 0.01$ ) in the Kangaroo Mother Care group as compared with those in the Traditional Care group.

#### Father involvement and HOME quality

Analyses indicate that higher father involvement (as indexed by the mothers' perception and reclassified as Low vs High) had a positive impact on the family context for both boys and girls ( $F(1, 275) = 11.4, p < 0.01$ ). In the high Father involvement subgroup, families are more stimulating ( $F(1, 275) = 5.2, p < 0.05$ ), more open to extended family and neighbours ( $F(1, 275) = 4.8, p < 0.05$ ) and the mother is more positive during interactions with her infant ( $F(1, 275) = 9.7, p < 0.01$ ) (data not in table).

#### Infant Developmental Quotient

After controlling for infant neurological status, results indicated a low correlation between Father Involvement and HOME scores ( $r = 0.16, p < 0.01$ ), which was significant with only 3% of common variance. At this point, it was decided that these variables would be analyzed as independent potential contributors to infant development. The first results indicated significant Father involvement ( $F(1, 302) = 5.8, p < 0.02$ ) and Gender effects ( $F(1, 302) = 5.2, p < 0.03$ ) on infants' Developmental Quotient favouring infants with high Father involvement. However, the Gender difference was only significant in the low Father Involvement subgroup ( $F(1, 302) = 9.0, p < 0.01$ ) where the boys in the Traditional Care group scored 4 to 6 points below the Kangaroo Mother Care boys and below both groups of girls (Fig. S1a). Contrasting effects were observed in the Intervention group where boys and girls obtained equivalent Developmental Quotient scores irrespective of the father's involvement level. These results suggest a positive effect of high Father Involvement and a protective effect of the Kangaroo Mother Care intervention on the boys' Developmental Quotient scores in the low Father Involvement families.

As expected, we found a strong association between the HOME score and the infants' developmental quotient ( $F(2, 325) = 5.6, p < 0.01$ ), indicating a better cognitive performance in infants who benefit from a more positive family environment during their first year of life. According to the categorization of the HOME scores as Low ( $\leq 25$ th percentile), Medium ( $> 25$ th and  $\leq 75$ th percentile) or High ( $> 75$ th percentile), the Developmental Quotient levels vary from 100 to 102 and 104 and this statistically significant difference ( $F(2, 325) = 5.5, p < 0.01$ ) was mainly attributable to the Traditional Care infants (both boys and girls), while Kangaroo Mother Care infants' Developmental Quotients did not differ across families' HOME categories (Fig. S1b).

#### DISCUSSION

A group of low birthweight infants randomized to either Kangaroo Mother Care or Traditional Care was followed until one year of age, that is, 69% and 53% of the Kangaroo intervention and Traditional Care infants in the original sample respectively. This number was based on the number of families the social worker had time to meet with between 9 and 12 months of the infant's corrected age and on the availability of the neurological and psychological tests. These differential and non-random rates of attrition might impair the interpretation of results, for we cannot be 100% sure that the two groups we analyzed are comparable as in the original random assignment. However, there were no between-group sociodemographic or physiological differences at birth.

It might be odd to read that the number of days in the hospital was similar in both groups when Kangaroo Mother Care is usually reported to be characterized by an earlier discharge. The first reason is that the discharge regulation in the Traditional Care group was reduced to 35 weeks or 1700 g in this hospital. Secondly, in this study, the group difference varies according to the infant's age at birth. For example, infants born before 30 weeks were discharged 15 days earlier in the Kangaroo Mother Care group, those born between 30 and 32 weeks of gestational age were discharged 5 days earlier and those born after 32 wga (mean of 33.7) were discharged only 1 day earlier.

#### The caregiving environment

The main finding of this study was the effect of the Kangaroo Mother Care intervention on the caregiving environment. During the first year of the infant's life, they received more developmental opportunities than those in Traditional Care families. Our interpretation is that a transactional phenomenon is involved, whereby parents learn intimacy from their first close contact with the infant and soon attune their caregiving behaviour to its developmental needs. This supplementary stimulation might begin soon after birth and might provide kinesthetic and vestibular stimulation to the infant, whose responsiveness gives the mother a fresh view of parenting and a new feeling of competence. This Kangaroo Mother Care effect has no direct comparison in the literature. However, Kangaroo mothers are reported to be

1 significantly more sensitive (16), more involved in caregiv-  
2 ing activities such as bathing, diapering, sleeping with their  
3 babies, and spend more time than usual providing care (13)  
4 and breastfeeding (32). Kangaroo Mother Care is also  
5 reported to improve parental mood, perceptions, and inter-  
6 active behaviour (17). In our study, mothers were also  
7 reported to have greater confidence in their infants' abilities  
8 and spoke more positively about their low birthweight  
9 infants (15). The family organization thus appears to be a  
10 natural extension of the first intimate relationship devel-  
11 oped during the carrying period after birth.

### 12 **The father's involvement**

13 The positive impact of the father's participation is not some-  
14 thing new per se (33), but it represents a significant result of  
15 this 24-h-a-day intervention, where the Kangaroo Mother  
16 Care procedures involve the father as a direct provider of  
17 care during the at-home daily routine. This high father  
18 participation has also recently been documented in studies  
19 where Kangaroo fathers were more sensitive and provided a  
20 better home environment (34) and had a more positive  
21 perception of the child (33). Our interpretation is that as he  
22 becomes co-responsible (with the mother) for the infant's  
23 health from the time the carrying position is first used, he  
24 also feels more involved and develops a more sensitive  
25 approach to his child than Traditional Care fathers.

26 The hypothesis suggesting that the HOME environment  
27 and Father Involvement could mediate the association  
28 between the Kangaroo Mother Care intervention and devel-  
29 opmental quotient was not confirmed and these variables  
30 appear to act independently on Developmental Quotient  
31 during the infants' first year of life. Results rather confirm  
32 the moderating effects of these environmental variables on  
33 infant development.

34 The father's direct contribution to infant Developmental  
35 Quotient has been systematically tested in this study and  
36 infants whose mother scored 'high' for father participation  
37 had a higher Quotient than those who scored 'low' for  
38 father participation. This result was not surprising as father  
39 involvement has a very well-documented positive impact on  
40 infant cognitive development (35). What is new, however, is  
41 the link with the Kangaroo Mother Care intervention as an  
42 inducer of father participation. This finding supports the  
43 idea that father involvement in the Kangaroo Mother Care  
44 method is an enrichment for the family of the premature  
45 child. We suggest that early introduction of Kangaroo  
46 Mother Care after birth leads to higher father participation,  
47 where the father becomes proud of his tiny infant and is  
48 more likely to help him grow better.

49 An additional result was obtained in this study. Boys and  
50 girls do not appear to benefit equally from the Kangaroo  
51 Mother Care intervention. The boys were protected against  
52 a developmental deficit in the Kangaroo group and this  
53 result became obvious in the low Father involvement and in  
54 the low HOME subgroups. In contrast, the girls' Develop-  
55 mental Quotient scores were more directly related to the  
quality of their family environment than their belonging to  
the Kangaroo Mother Care group. As these family

environment scores had been obtained from observations of  
the mother's attitudes and behaviours, we conclude that the  
girls are more directly marked by their mother independ-  
ently of the Kangaroo intervention effects. This differential  
gender effect suggests that boys are more protected by  
Kangaroo Mother Care and that girls are more protected by  
the family environment created by their mother. One  
explanation might be that the boys' health status at birth  
was different. For example, the boys needed intensive care  
more frequently at birth (17%) than girls (11%) and were  
more at risk (neurologically) at 6 months of corrected  
age (28%) than girls (17%). The boys were neither lighter,  
nor shorter than girls and their head circumference was not  
different at birth. Yet, they were more at risk neurologically.  
As is now sometimes hypothesized (17), we suggest that the  
Kangaroo Mother Care intervention directly modifies the  
immature brain and thus gives developmental opportunities  
to at-risk boys.

Girls, however, appear to be more indirectly affected by  
Kangaroo Mother Care via the changes induced in the  
family environment. As this intervention is thought to  
minimize the risk for maternal postpartum depression  
(17,36) and to improve maternal mood, perceptions and  
interactive behaviours (36), it could help modify the climate  
and improve the quality of the mother-daughter relation-  
ship. These differential effects on gender should therefore  
be re-examined.

### CONCLUSION

It appears that the Kangaroo Mother Care intervention  
includes two levels of consequences. The first enhances the  
quality of the family as a developmental context, including  
increased father involvement. The second is more idiosyn-  
cratic in the sense that it specifically helps the infant's  
delicate health at birth. The first consequence on the exter-  
nal environment is independent of the second, which is  
related to the infant's health. While we cannot attempt to  
modify infant health characteristics, we can introduce either  
of the former to help children grow better. Enhancing the  
father's sense of responsibility and competence through this  
early intervention could be an excellent means to ensure a  
mature involvement in the future of children. Gender differ-  
ence is a variable that should be taken into account when  
evaluating the long-term effects of the Kangaroo Mother  
Care intervention. We hypothesize that at-risk male infants  
benefit more directly from the intervention, while female  
infants benefit more indirectly through the family changes  
induced by the mother. These results suggest, first, that both  
parents should be involved as direct actors in the Kangaroo  
Mother Care procedure and secondly that this intervention  
should be directed more specifically at infants who are more  
at risk at birth. We must not forget that the original goal of  
the Kangaroo Mother Care intervention was to reduce the  
mortality and morbidity of more at-risk infants. If, for any  
reason, one had to choose a subgroup of Kangaroo Mother  
Care recipients, this study suggests focusing on more at-risk  
infants.

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**SUPPORTING INFORMATION**

Additional supporting information may be found in the online version of this article.

**Figure S1** (a) Father support and Developmental quotient. (b) Quality of HOME and ~~infant DQ~~.

**Table S1** Comparison between the Kangaroo Mother Care and the Traditional Care ~~control~~ groups based on sociodemographic, labour and delivery characteristics.

**Table S2** Comparisons between Kangaroo Mother Care and Traditional Care groups based on factors related to the newborn infants.

**Table S3** Estimated marginal mean of HOME environment by Intervention groups moderated by infant gender and neurological status.

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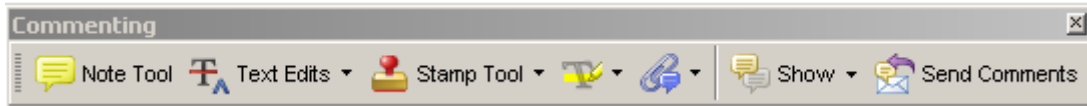


## USING E-ANNOTATION TOOLS FOR ELECTRONIC PROOF CORRECTION

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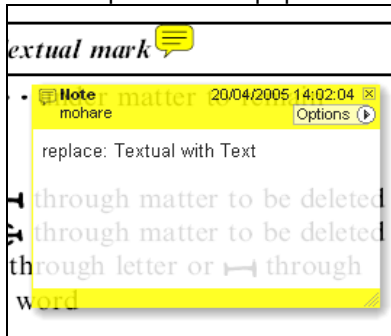
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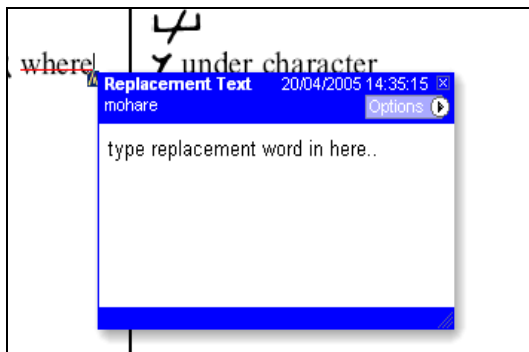


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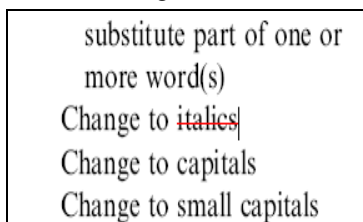


How to use it:

1. Select cursor from toolbar
2. Highlight word or sentence
3. Right click
4. Select Replace Text (Comment) option
5. Type replacement text in blue box
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### Cross out text tool — For deleting text when there is nothing to replace selection

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How to use it:

1. Select cursor from toolbar
2. Highlight word or sentence
3. Right click
4. Select Cross Out Text

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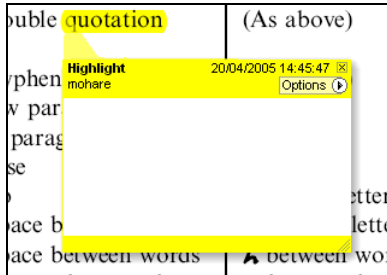


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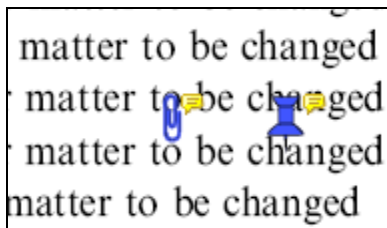


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2. Highlight the desired text
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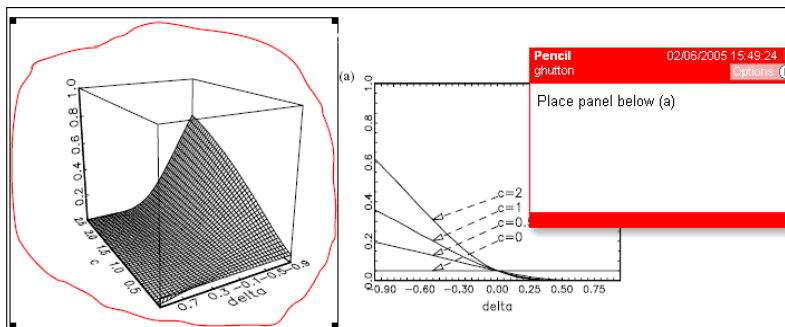


How to use it:

1. Click on paperclip icon in the commenting toolbar
2. Click where you want to insert the attachment
3. Select the saved file from your PC/network
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How to use it:

1. Select Tools > Drawing Markups > Pencil Tool
2. Draw with the cursor
3. Multiple pieces of pencil annotation can be grouped together
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