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Social support and regular physical activity: Does planning mediate this link?

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Objectives: Social support for physical activity is reliably associated with regular physical activity, however the social cognitive processes, particularly post-intentional processes, that can explain this link have not been well characterised. In this study we examined the extent to which the relationship between social support for physical activity and subsequent physical activity can be accounted for by planning processes.

Design & Method: The design was prospective observational and the sample consisted of 903 university students. Participants completed standard TPB, planning and physical activity measures at 2 time points, approximately 7 weeks apart. A gender stratified multiple mediation model was conducted to test the study hypotheses.

Results: A significant interaction between social support and gender was observed. This indicated that lower levels of social support for physical activity were associated with lower levels of physical activity at time 2, for women only. In multiple mediation analysis this was partly explained by the indirect effects of social support through perceived behavioural control and coping planning.

Conclusion: These findings highlight the importance of interpersonal processes in understanding the post-intentional determinants of regular physical activity. It is likely that planning processes relating to physical activity are often influenced by those in the ongoing immediate social environment who support this behaviour. Future development of theory and interventions should take account of the socially interactive nature of planning processes.

Introduction

Social support for regular physical activity has been one of the most studied psychosocial determinants of regular physical activity (Trost et al., 2002; Courneya et al., 2000; Sallis et al., 1992b). Duncan et al., (2005) provides a general definition of social support that subsumes a number of different theoretical approaches. They propose that social support refers to any behavior that assists an individual in achieving desired goals or outcomes. Several studies have clearly shown that social support for physical activity is reliably associated with greater levels of physical activity (Trost et al., 2002), particularly among women (Sallis et al., 1992a; Sallis et al., 1999). Previous work in the area of social cognition and physical activity has shown that this link can be partly explained by the relationship between social support for physical activity and beliefs about capability or control of engaging in regular physical activity e.g. self-efficacy (McAuley et al., 2003) from social cognitive theory (Bandura, 2004) and perceived behavioral control (Courneya & McAuley, 1995) from the theory of planned behavior (Ajzen, 1991). In these studies social support for physical activity is hypothesised to enhance control/efficacy beliefs relating to participating in regular physical activity. For example in social cognitive theory, social support could be viewed as a potential source of self-efficacy e.g. social supportive relationships may provide self-efficacy enhancing vicarious experience or verbal persuasion relating to regular physical activity (Bandura, 1997).

Recent work on the social cognitive determinants of regular physical activity has focused on post-intentional processes that facilitate the translation of intentions into action (Sniehotta et al., 2005b). This research shows that processes relating to the post-intentional planning of behavior are important intermediate mechanisms operating between intention and behavior (Sniehotta, 2009). Action planning and coping planning in particular have emerged as two key

constructs that operate between intention and behavior (Araujo-Soares et al., 2009). Action planning is defined as a post-intentional process that links goal-directed responses to situational cues by specifying when, where, and how to act in accordance with one's goal intention. Coping planning is conceptualized as an independent planning cognition that prepares a person for successful coping with situations in which strong cues invite both unintended responses (e.g. habits) and intentional responses (e.g. newly planned actions) (Sniehotta et al., 2006). These variables have been shown to predict physical activity and other health behaviors (Schwarzer et al., 2007) and interventions that can enhance planning have been shown to lead to increased physical activity, particularly in motivated patient groups (Sniehotta et al., 2005a).

Planning processes aim to create new contingencies between (external) situational cues and behavioural responses (e.g. swimming) directly conducive to the pursuit of goal intentions (e.g. being physically active) (Sniehotta, 2009). It is likely that situational cues will often be social in their nature. For example a social action plan might take the form of I will go for a run when I meet X in the park on Tuesdays, where X is some ongoing social contact. A coping plan may also often be social in it's nature in that it may be another person or a social interaction that prevents unwanted influences on behaviour e.g. I will go for run even if I am tired because X will be calling by to go running with me. However there are limited data on how such social supportive interactions relate to these planning processes, so these hypothesised links remain speculative.

Understanding how planning relates to social support is therefore important for furthering our understanding of why social support for physical activity is a key determinant of regular physical activity in some groups. In this study we examine whether planning processes mediate the relationship between social support and regular physical activity. By way of comparison we

also examine how the proximal predictors from the theory of planned behavior variables (intention and perceived behavioral control) mediate this association.

Social support in the present study is conceptualised as received social support for engaging in physical activity. This type of social support refers to support received from other people i.e. an interpersonal process, and can be distinguished from perceived support, which refers to one's perception of potential access to social support and is more typically conceived of as an intrapersonal process (see Uchino, 2009 for a detailed discussion of this distinction). This focus on interpersonal as opposed to intrapersonal processes is in line with an underlying aim in this study to understand how socially supportive interactions might determine regular physical activity in terms of known social cognitive determinants of regular physical activity. Therefore social support is presented as a distal predictor that can influence proximate theory of planned behaviour variables (intention and perceived behavioural control) and post-intentional processes such as planning (Sniehotta, 2009).

It is not entirely clear why gender differences have been observed in the link between social support and physical activity. One speculative hypothesis may be that it is due to the importance of agency as opposed to communion that are thought to characterise male and female (i.e. an intrapersonal versus interpersonal orientation, respectively) differences in social behaviour (Helgeson, 1994). In light of the previously observed gender differences (Sallis et al., 1992a; Sallis et al., 1999) we also examined whether gender may moderate the relationship between social support and physical activity. The main hypotheses for the present study however, was that the proximal predictors from the TPB (intention and perceived behavioural control) and planning variables (action and coping planning) would mediate any observed relationships between social support and regular physical activity.

Social support for physical activity.

Method

Design

Data were collected as part of the Student Activity and Lifestyle at Aberdeen (SALSA) study, a prospective cohort study investigating levels and determinants of physical activity and other health behaviors amongst students of a Scottish university. Measurements used for the present analysis were taken in the first two weeks of the academic year (Time 1) and approximately 7 weeks later (Time 2) using a web-based questionnaire (Skar et al., 2008).

Participants and procedure

All resident students of the university (approximately 10,000) received an email invitation to take part in the SALSA online study on a voluntary basis sent by the IT department at the beginning of the academic year. An email with a link to the follow-up questionnaire was sent 7 weeks later. Informed consent was given by 1,418 students. Of these, 887 were female (62.6%), mean age was 22.2 years (range 16 to 62 years), 93.7 per cent of the participants were 30 years old or younger. Ethical approval was granted by the University psychology ethics committee.

Measures

Physical activity

Physical activity was measured at Time 1 and Time 2 using the Godin Leisure Time Exercise Questionnaire -LTEQ (Godin & Shephard, 1985). A measure of frequency of strenuous physical activity (e.g. “heart beats rapidly”) over the previous 7 days was used as the dependent variable. Godin’s LTEQ is one of the best studied self-report measures in both patient (Motl & Snook, 2008) and non-patient groups and has shown satisfactory concurrent validity against accelerometry measures ($r>0.30$) (Sallis & Saelens, 2000). Frequency of strenuous physical activity was chosen as the dependent variable for this study, as it has been shown to be most

reflective of habitual physical activity when compared with more objective measures (Richardson et al., 2001).

Theory of planned behavior

The proximal predictors of behavior from the theory of planned behavior (a 3-item intention scale and a 4-item perceived behavioral control scale) were measured using the items used by Armitage (Armitage, 2005). The intention items were: "How often do you intend to take part in regular physical activity? *never–frequently*," and "I want to exercise regularly *definitely do not–definitely do*" and an additional third intention item " I do not intend to participate in regular physical activity *disagree- agree.* The perceived behavioural control items were:
"To what extent do you see yourself as being capable of participating in regular physical activity? *incapable–capable*"; "How confident are you that you will be able to participate in regular physical activity? *not very confident–very confident*"; "I believe I have the ability to participate in regular physical activity. *definitely do not–definitely do*"; and "How much personal control do you feel you have over participating in regular physical activity? *no control–complete control.*" Both intention and perceived behavioural control were measured using 7 point scales.

Planning

Action planning was measured using a 5 item scale (Sniehotta et al., 2005b). Items began with the stem "I have made a detailed plan regarding…… when to participate in regular physical activity, ... where to participate in regular physical activity, ... how to participate in regular physical activity, … how often to participate in regular physical activity, ... with whom to participate in regular physical activity." The responses to the 5 items were on a 7 point scale and ranged from *1 Disagree to 7 Agree*. Coping planning was measured using a six item scale (Sniehotta et al., 2005b). Items also began with the stem "I have made a detailed plan

regarding… what to do if something interferes with my plans for regular physical activity, ... how to cope with possible setbacks from regular physical activity, … what to do in difficult situations in order to act according to my intentions for regular physical activity, … which good opportunities for participating in physical activity to take, … when I have to pay extra attention to prevent lapses from participating in regular physical activity." The responses to the 5 items were on a 7 point scale and ranged from *1 Disagree to 7 Agree*.

Social support for regular physical activity

Social support for physical activity was measured using a 3-item scale that was based on a previous measure (Sallis et al., 1987) and was designed to be concordant with the dependent physical activity measure in this study. The items began with the stem "In the last week I.....had somebody to encourage me to participate in physical activity on a regular basis, ...had somebody to participate in physical activity with me, ...felt supported in having a regular pattern of physical activity". The responses to the 3 items were on a 7 point scale and ranged from *1 Disagree to 7 Agree*.

Statistical analysis

Descriptive statistics were used to examine means, variability and bivariate correlations between the main study measures. Internal consistency for multi-item scales was calculated using Cronbach's alpha. In order to test whether there was an interaction between gender and social support, moderated regression analysis were carried out. A multiple regression model predicting physical activity at time 2 with physical activity at time 1, social support at time 1, gender and a social support by gender interaction term as predictors was carried out. Two multiple mediation analysis were employed to test firstly whether intention and perceived behavioral control and secondly action planning and coping planning significantly mediated the observed associations

between social support and regular physical activity at time 2, adjusting for physical activity at time 1. All social cognitive variables used in this analysis were Time 1 measures.

The total effect (weight c) of an independent variable (IV) on a dependent variable (DV) is composed of a direct effect (weight c') of the IV on the DV and an indirect effect (weight axb) of the IV on the DV through a proposed mediator (M). Weight 'a' represents the effects of the IV on the M, whereas weight 'b' is the effect of the M on the DV. In the case of multiple mediators, it is possible to estimate the total indirect effects as well as the specific indirect effects. This analysis was gender stratified following the test for interaction between gender and social support in the multiple regression model predicting physical activity at Time 2. The bootstrapping method outlined by Preacher & Hayes was employed with 5000 bootstrap samples to assess indirect effects (Preacher & Hayes, 2008). The analysis was conducted using SPSS 16 and the multiple mediation macro for SPSS that has been developed by Preacher & Hayes (2008).

Results

Dropout Analysis

Out of the 1,418 participants at baseline, 903 (63.6%) completed the follow-up. Comparisons between variables under investigation revealed that participants that dropped out of the study were not significantly different in terms of age, time 1 levels of Physical activity, PBC or social support. Male participants were more likely to drop out (42%) than females (33%), $p = 0.001$.

Descriptive Statistics

Table 1 presents means, standard deviations and correlations for the study variables. All variables correlated significantly at the $p < .01$ level. Cronbach's alpha's are presented in table 1 and were satisfactory and comparable to the previous studies (Armitage, 2005; Sniehotta et al.,

2005b). All observed correlations were in the predicted direction and were consistent with previous research (Courneya et al., 2000).

Moderation analysis

Table 2 presents the results of the moderated regression analysis. As indicated in Table 2 the gender by social support interaction term was statistically significant. To probe the gender by social support interaction we plotted regression lines of best fit at high (one standard deviation above the mean) and low levels (one standard deviation below the mean) of social support for men and women. Next, we conducted further tests separately on the male and female lines to determine whether they differed from zero. This revealed that the line for women differed significantly from zero (β =0.146, t =3.716, $p < .001$), but the line for men did not (β =-0.008, t = -0.148, p =0.882). As illustrated in Fig.1, physical activity at Time 2 was significantly lower among women who had lower levels of social support.

Mediation analysis

The gender stratified mediation analysis is summarized in Table 3. In men greater social support for physical activity was associated with higher levels of PBC. Higher levels of PBC were associated with more physical activity at Time 2. The indirect effect of social support for physical activity through PBC was statistically significant for men. Social support for physical activity was associated with action planning, however there were no associations between action and coping planning and physical activity at Time 2 in men. The total effect of social support for physical activity at Time 1 on physical activity at Time 2 was not statistically significant for men. For women greater social support for physical activity was associated with stronger intentions and higher PBC and higher PBC was associated more physical activity at Time 2. The indirect effect of social support for physical activity at Time 2 through PBC was statistically

significant for women. Social support for physical activity was associated with action and coping planning, while only coping planning was associated with physical activity at Time 2 in women. The indirect effect of social support for physical activity through coping planning was statistically significant for coping planning only; however the size of the indirect effect was almost identical for action planning. The total effect of social support for physical activity at Time 1 on physical activity at Time 2 was statistically significant for women.

In summary the analysis shows that, as expected, perceived behavioral control was a partial mediator of the relationship between social support for physical activity and physical activity at Time 2 . The multiple mediation model for women also showed that coping planning was a significant partial mediator of the social support-physical activity relationship.

Discussion

The present study found that enhanced coping planning may partly explain the social support-physical activity link in women. This study also confirmed previous findings showing that the relationship between social support for physical activity and physical activity can be partly explained by control beliefs. Specifically perceived behavioural control from the theory of planned behaviour partly mediated the effect of social support on regular physical activity in prospective analysis in both men and women, mirroring previous findings (Courneya & McAuley, 1995). As we have already mentioned in the introduction this is consistent with socially facilitated behaviour change techniques such as verbal persuation and modelling that are known to enhance beliefs about control over behaviour (Bandura, 1997). Social support for physical activity by defintion includes having someone to engage in physical activity with and someone to encourage you to engage in physical activity, which should, according to the social

cognitive theory (Bandura, 1997), have a positive impact on beliefs about control over this behaviour.

The study findings also highlight once again that social support is a more powerful determinant of regular physical activity for women than men (Sallis et al., 1992a). This suggests that research and practice in this area should clearly consider the role of gender differences in understanding the determinants of the adoption and maintenance of regular physical activity. Although it is difficult to conceive of interventions that aim to increase physical activity that do not either implicitly or explicitly include a social supportive component, particularly where researchers interact with participants, it is likely that socially supportive interventions for women will be more efficacious than for men. The non-significant total effect of social support on physical activity for men could have been the result of a suppression effect of some of the other social cognitive variables. As shown in the results, intention was negatively associated with PA and thereby suppressed the social support and physical activity association. This suppression could have "suppressed" the positive mediated effect of PBC, which when combined could have resulted in a non-significant total effect. Therefore it is important to interpret the results for the male sub-sample in this study with caution.

The finding in the present study showing that coping planning partly explains the relationship between social support and physical activity in women may shed some new light in understanding this relationship. One recent intervention study in breast cancer survivors that involved theory based information and pedometer self-monitoring intervention to enhance physical activity found that action planning was improved in the intervention group (Vallance et al., 2008). As this study implicitly involved social support for physical activity beyond that which would have otherwise available i.e. support from those delivering the behaviour change

intervention, this intervention has clearly a social support component. As the results in the Vallance et al. (2008) study indicate it is possible that social support for physical activity may facilitate the formation of plans and in particular plans to overcome the barriers that can prevent individuals from taking part in regular physical activity, i.e. coping planning. Although Vallance et al. (2008) did not include a measure of coping planning in their study, it is clear that action and coping planning are indeed distinct but highly correlated constructs e.g. in the present study r=0.67, and it is possible that an intervention that had an influence on action planning may have also had an effect on coping planning.

Action planning and coping planning as they are currently conceived are not interpersonal but intra-individual processes. Future work should consider how these processes play out in a more social, particularly dyadic context. The dyad is of interest for three key reasons. Firstly most humans live and function in a limited number of ongoing dyadic relationships of some description for large parts of their lives e.g. mother-child, spousal pair relationship, informal caregiver to elderly parent (Baumeister & Leary, 1995). Therefore co-regulatory processes (Saxbe & Repetti, 2010; Sbarra & Hazan, 2008), as opposed to self-regulatory processes, may be critical determinants for understanding the adoption and maintenance of key health behaviours. Behavioural co-regulation in this context refers to the process whereby each individual in a relationship serves as the primary behavioural regulator for their partner. Secondly there is some evidence that collaborative planning can lead to greater behaviour change than individual planning (Prestwich et al., 2005). Finally the dyad offers an under examined target for intervention and a new unit for analysis that could potentially enhance the science and practice of physical activity behaviour change. These approaches could help bridge the theoretical gap between interpersonal contexts e.g. social supportive interactions, and

the self-regulation of regular physical activity. It is important to note that social exchange processes in relations to health behaviour have been studied for some time (Lewis & Rook, 1999; Umberson, 1992), however this literature has been somewhat separate of work on the self-regulation of health behaviour, particularly work focusing on social cognitive processes.

Other recent relevant evidence from a systematic review and meta-analysis of intervention studies which aimed to increase self-efficacy for physical activity found that physical activity self-efficacy was higher when vicarious experience was included as an intervention technique compared to those studies where it was not (Ashford, Edmunds & French, in press). These findings raise the question about whether more socially interactive behaviour change techniques for physical activity e.g. behavioural modelling, are potentially more efficacious than individual based techniques that do not include a socially interactive component. Duncan et al.'s (2005) definition of social support would suggest that this type of intervention could also be categorised as a social support intervention for physical activity i.e. social support refers to any behavior that assists an individual in achieving desired goals or outcomes. Future systematic reviews and meta-analyses could examine whether behaviour change is greater when socially supportive behaviour change interventions are used compared to when they are not to begin to answer this question in the context of enhancing physical activity. Finally future studies should also aim to identify which kinds of social support e.g. emotional support, practical/tangible support or companionship are most important for which kinds of physical activity. This work would be particularly important for developing social support interventions for given behaviours.

There are of course a number of limitations to present study, which should be highlighted. Firstly the correlational design precludes causal inferences. This is a common issue

in observational health behaviour studies, which should be given due consideration (Weinstein, 2007). Secondly the student sample may prevent generalisation, however such samples are frequently used in key studies (Sallis et al., 1999) that attempt to answer important questions about the psychosocial determinants of health behaviour. A further point in relation to the study sample concerns the fact that there was a smaller sample of men than women in this study. It is worth considering that observed gender differences in social support, social cognitive and physical activity associations may be due to differential statistical power in the analysis of these two sub-groups. Finally corroborating self-report physical activity data with accelerometer or other more objective data always provides a more compelling set of findings. Nevertheless the present analysis throws some new light on the relationship between social support for physical activity and subsequent physical activity by confirming the role of perceived behavioural control and identifying coping planning as a potential mediator of this relationship.

Conclusion

These findings highlight the importance of interpersonal processes in understanding the social cognitive determinants of regular physical activity. It is likely that planning processes relating to physical activity are often influenced by those in the ongoing immediate social environment. Future development of theory and interventions should take account of the socially interactive nature of planning processes. In particular a greater emphasis on how physical activity behaviour may be as much a problem of co-regulatory as opposed to self-regulatory processes.

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Table 1

Correlation of physical activity, social support, theory of planned behaviour and planning.

	Mean (SD)	Cronbach's alpha	Range	1.	2.	3.	4.	5.	6.
1. Physical activity Time 1	2.17 (2.39)	n.a	0-10	1					
2. Physical activity Time 2	2.19 (2.46)	n.a.	0-10	.68**	1				
3. Social support Time 1	3.31 (1.93)	0.81	1-7	.34**	.29**	1			
4. PBC Time 1	5.45 (1.34)	0.90	1-7	.43**	.42**	.32**	1		
5. Intention Time 1	5.76 (1.18)	0.72	1-7	.38**	.34**	.28**	.68**	1	
6. Action planning Time 1	3.36 (1.97)	0.95	1-7	.36**	.32**	.33**	.40**	.40**	1
7. Coping planning Time 1	2.51 (1.60)	0.95	1-7	.35**	.34**	.28**	.29**	.24**	.67**

**P<0.01, PBC: Perceived behavioral control.

Table 2

Multiple regression analysis testing the moderating effect of gender on the social support and physical activity at Time 2, controlling for physical activity at Time 1.

	B	95% CI for B		Std. Error	Standardized Coefficient Beta	P
Physical activity Time 1	.678	.625	.732	.027	.650	<.001
Social support Time 1 (centered)	-.163	-.390	.065	.116	-.128	.161
Gender (1 is male, 2 is female)	-.258	-.515	.001	.131	-.050	.050
Gender X Social support Time 1 (centered)	.154	.025	.284	.066	.211	.020

Note. Adjusted R^2= 0.47, F (4, 891) =197.335, p<0.001.

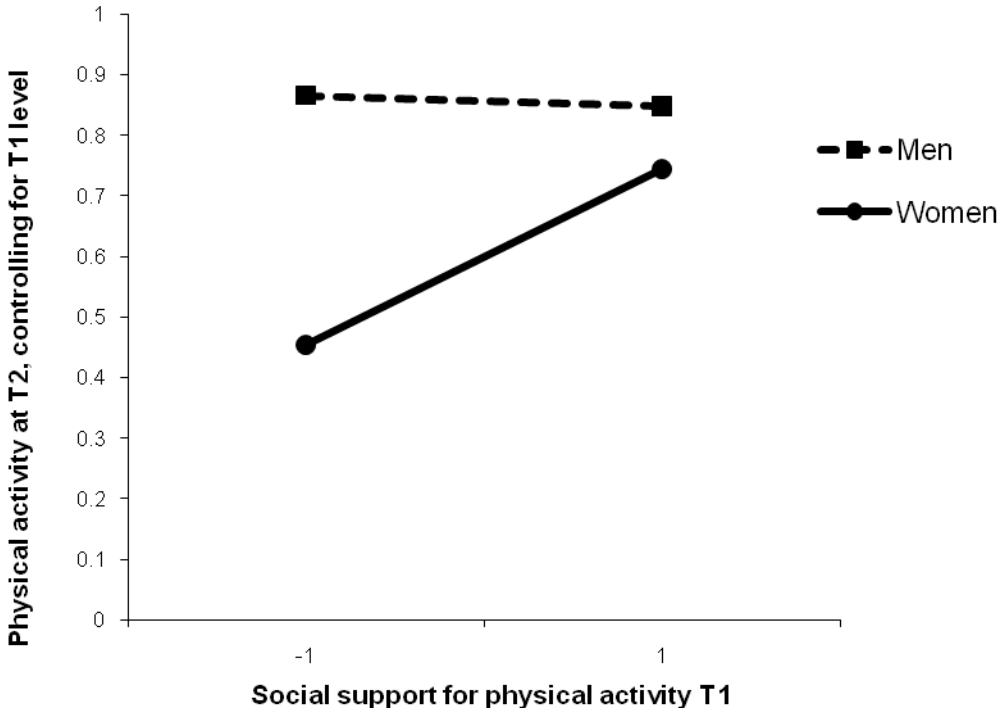
Table 3

Summary of prospective mediation analysis for social support, TPB variables, planning and physical activity for men and women (5000 bootstrap samples).

Independent variable (IV)	Mediating variable (M)	Dependent variable (DV)	Effect of IV on M (a)	Effect of M on DV (b)	Direct effects (c')	Indirect effect (a x b) [95% BC CIs]	Total effects (c) [Mediation]
MEN							
Social support T1	Intention T1	Physical Activity T2	.063	-.300*	-.037	-.019 [-.061, -.001]	.002 [None]
	PBC T1		.121**	.471**	----------	.057*[.020, .117]	[Partial]
Social support T1	Action planning T1	Physical Activity T2	.130*	.030	-.003	.004 [-.014, .036]	.003 [None]
	Coping planning T1		.064	.044	----------	.002 [-.001, .030]	[None]
WOMEN							
Social support T1	Intention T1	Physical Activity T2	.112**	.085	.112**	.010 [-.001, .030]	.143** [None]
	PBC T1		.122**	.169*	----------	.021*[.003, .045]	[Partial]
Social support T1	Action planning T1	Physical Activity T2	.282**	.071	.100*	.020 [-.001, .053]	.140** [None]
	Coping planning T1		.161**	.123*	----------	.020*[.001, .047]	[Partial]

* P <0.05, ** P<0.01. T1: Time 1, T2: Time 2, PBC: Perceived behavioral control, 95% BC CIs: 95% Bias corrected confidence intervals. Mediation models included Physical Activity T1 as a covariate.

Social support for physical activity.



T1: Time 1, T2: Time 2.

Figure 1. The moderating effect of gender on the relationship between social support and physical activity.